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CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Measurement of the Speed of a Railway Train, by means of Electro-Magnetism. By Wm. C. McRea, Telegraphic Engineer.

The wheels of a car rotate a certain number of times in going over a given space of road; for example, suppose a car-wheel to be eight feet in circumference, it will rotate 660 times in going the distance of a mile. Now, if the car were so constructed that the body would always remain at an equal distance from the axle, which is prevented by the motion given it by the springs, it would not be difficult to bring the wheel at each revolution to so bear upon a lever, as to rotate a wheel inside the car, which might have as many cogs as the car-wheel rotates times, in going a mile. Or, by a series of clock-work wheels, the indicating wheel might contain a fractional number of cogs in proportion to the number of times which the car-wheel would rotate in a given distance.

The difficulty occasioned by the unsteady motion of the car, owing to the springs, may be overcome by the use of a magnet, battery, and galvanic circuit. The latter to be so arranged as to be broken at each revolution of the car-wheel or axle. So by this means the operation of the magnetic contrivance would be to move the speed-indicator the distance of one cog.

A contrivance of this kind may be so constructed as not to require winding, in order to have it in readiness for use.

The indicator may be so constructed as to have an index placed over

it, in such a position that the hand on the indicator should move it a sufficient distance to show at each successive rotation, the number of miles already traveled.

The kind of battery most suitable for such a contrivance, would be that of the "sand battery;" which, if properly constructed, may be made to act with as much certainty as any other, and at far less expense. This battery should be constructed with sand of such quality as is used by the manufacturers of glass, that is, free from dirt of any kind. The battery cup may be that of the ordinary kind, as used in Grove's battery, or if larger glass or porcelain jars can be obtained, they would doubtless be better, affording an opportunity for the use of larger plates of zinc and copper; these should be placed about an inch apart, and the sand packed tightly around them. The zinc should be amalgamated, and the copper rubbed with a piece of emery paper, before placing in the cup; the sand should then be well moistened with sulphuric acid, diluted in the usual proportion for battery purposes. Intensity may of course be increased by increase of acid. A battery of this kind would stand for some weeks, only requiring the addition of a little acid each day, according as the strength of that first put in, became exhausted. A series of cups of this kind could be carried on board of a train, without the difficulties which would arise from that of almost any other battery.

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*Siemens's Regenerative Steam Engine.** By C. W. Siemens, Esq., C. E.

Substance of a lecture recently delivered at the Royal Institution.

The steam engine of Watt was composed of four organic parts, namely —1. The furnace, or chamber of combustion, with its flues and chimney. 2. The boiler, or steam generator. 3. The steam vessel, or cylinder, wherein the elastic force of the steam is imparted to the piston, or other first moving parts of the machinery. 4. The condenser, where the elastic force of the steam is destroyed by abstracting its latent heat by injection of cold water, or by exposure of cooled metallic surfaces. In the case of high-pressure engines, it would seem that the condenser was suppressed; but it might be said that this class of engines makes use of one great common condenser, namely, the atmosphere, the separate condenser possessing only the advantage of relieving the working piston of the opposing atmospheric pressure. The only essential improvement of the steam engine that has been introduced since the time of Watt, consists in working the steam expansively, whereby a considerable economy has been obtained; but it is well known that Watt foresaw the advantages that would be realized in this direction.

The lofty superstructure proved the soundness of the foundation Watt had laid; and it would seem hopeless to change the same, unless it could be proved that the very principle regarding the nature of heat, whereon Watt had built, had given way to another more comprehensive principle. The engine of Watt was based upon the material theory of heat that prevailed at his time, and almost to the present day. According to this theory, steam was regarded as a chemical compound of

* From the Lond. Mech. Mag., July, 1856.

water, and the supposed imponderable fluid "heat," which possessed amongst others the property of occupying under atmospheric pressure nearly 1700 times the bulk of the water contained in it. The Boulton and Watt condensing engine took the full advantage of this augmentation of volume, which effected a proportionate displacement of piston, and the condensation of the steam obviated all existing pressure to the piston.

In the course of the last few years our views of the nature of heat had, however, undergone a complete change; and, according to the new "dynamic theory," heat, as well as electricity, light, sound, and chemical action, are regarded as different manifestations of motion between the intimate particles of matter, and can be expressed in equivalent values of palpable motion and dynamic effect. In support of this theory he (Mr. Siemens) could not do better than refer to the able discourses, recently delivered in the Royal Institution, by Mr. Grove and Professor Thomson.

Viewed from the position of the new theory, the heat given out in the condenser of a steam engine represented a loss of mechanical effect amounting to $\frac{3}{4}$th parts of the total heat imparted to the boiler, and the remaining $\frac{1}{4}$th part was all the heat really converted into mechanical effect. The greater proportion of the lost heat might be utilized by a perfect dynamic engine. A vast field for practical discovery was thus opened out; but it might yet be asked whether it was worth while to leave our present tried and approved forms of engines to seek for economy, however great, in a new direction, considering the vast extent of our coal fields. The reply to this objection was that the coal, in its transit from the pit to the furnace, acquired a considerable value, which, for this country, might be estimated at £8 per horse-power per annum (taking a consumption of 13½ tons of coal, at an average expenditure of 12*s.* per ton).

Estimating the total force of the stationary and locomotive engines employed in this country, at 1,000,000 nominal horse-power, it followed that the total expenditure for steam coal amounted to £8,000,000 sterling per annum, of which at least two-thirds might be saved. In other countries, where coal is scarce, the importance of economy becomes still more apparent; but it is of the highest importance for marine engines, the coals whereof had to be purchased at transatlantic stations, at a cost of several pounds per ton, to which must still be added the indirect cost of its carriage by the steamer itself in place of merchandize.

These observations, Mr. Siemens thought, might justify him in bringing before the Institution an engine, the result of nearly ten years' experimental researches, which he thought to be the first practical application of the dynamic theory of heat, of which he was proud to call himself an early disciple. Others, more able than himself, might probably have arrived sooner at a practically useful result; but he might claim for himself at least that strong conviction, approaching enthusiasm, which alone could have given him strength to combat successfully the general discouragement and the serious disappointments he met with.

This engine, of which several diagrams and a model were exhibited, consisted of three essential parts, namely, the furnace; the working cylinder, with its respirator and heating vessel; and the regenerative cylinder. It consisted also of a boiler and condenser (unless the steam were discharged into the atmosphere); but these were not essential to the working of the engine, although of great practical utility. The regenerative cylinder had for its object alternately to charge and discharge two working cylinders, and the action of its piston might be compared to that of a hammer oscillating between two elastic anvils. The regenerative cylinder communicated at its one extremity with one working cylinder, and at the other extremity with another and similar working cylinder, and these communications were not intercepted by valves. The working cylinders were so constituted that their capacity for steam of constant pressure was the same, no matter where the working piston stood. Each consisted of a cylinder of cast iron, open at both ends, which was completely enclosed in another cylinder or heating vessel, one end of which was exposed to the action of a fire. Within the inner cylinder was a large hollow piston, filled with non-conducting material, to which was attached a long trunk or enlarged hollow piston rod of nearly half the sectional area of the piston itself. This trunk was attached to the working crank of the engine in the usual manner. The trunk of the second working cylinder stood precisely opposite, and was connected with the same crank, The piston of the regenerative cylinder was also connected with the same crank, but stood at right angles to the two working cylinders. The consequence of this arrangement was, that while the two working trunks made their strokes (the one inward and the other outward), the piston of the regenerative cylinder remained comparatively quiescent upon its turning or dead point, and *vice versa*. Around the two heating vessels boilers were disposed, which received the heat of the fire after it had acted upon the former. The steam generated within the boilers was introduced into the engine by means of an ordinary slide valve (of comparatively very small dimensions,) at short intervals, and when the piston of the regenerative cylinder was in its extreme position. The admission of the steam, which was of high pressure, took place on that side of the regenerative cylinder where compression by the motion of its piston had already taken place, and at the same instant a corresponding escape of expanded steam on the other side of the regenerative piston was allowed to take place into the atmosphere. The quantity of steam freshly admitted at each stroke did, however, not exceed one-tenth part of the steam contained in the working cylinders of the engine, and served to renew the same by degrees, while it added its own expansive force to the effect of the engine. The compression of the steam into either of the working cylinders, took place when its hollow piston stood at the bottom. While in this position the steam occupied the annular chamber between the working trunk and the cylinder, besides the narrow space between the cylinder and the surrounding heating vessel. The pressure of the steam being the same above and below the hollow piston, but the effective area below being equal to twice the area above, the working trunk attached to the piston would be forced outward through the stuffing box,

while the steam of the annular chamber above the piston passed through the narrow space intervening, into a space of twice the capacity of the annular chamber below the hollow piston. During its passage the steam had to traverse a mass of metallic wire gauze or plates, the respirator presenting a large aggregate surface, which reached at one end sufficiently downward into the heating vessel, that its temperature was raised from 600° to 700° Fahr., while its other extremity remained at the temperature of saturated steam, or about 250° Fahr. In consequence of the addition of temperature the steam received on its passage through the respirator, its elastic force was doubled, and it therefore filled the larger capacity below the hollow piston or displacer without loss of pressure. When the effective stroke of the working trunk was nearly completed, the regenerative piston commenced to recede, and the steam below the hollow piston expanded into the regenerative cylinder, depositing on its regress through the respirator the heat it had received on its egress through the same, less only the quantity that had been lost in its expansion below the working piston, and which was converted into dynamic effect or engine power, and which had to be supplied by the fire. The expansion and simultaneous reduction of temperature of the steam, caused a diminution of its pressure from four to nearly one atmosphere; and the working trunk could now effect its return stroke without opposing pressure, and while the second working trunk made its effective or outward stroke impelled by a pressure of four atmospheres.

The respirator which was invented by the Rev. Mr. Stirling, of Dundee, in 1816, fulfilled its office with surprising rapidity and perfection, if it were made of suitable proportions. Its action was proved at the end of the lecture by a working model. It had been applied without success to hot-air engines by Stirling and Ericsson, but failed for want of proper application; for it had been assumed (in accordance with the material theory of heat,) that it was capable of recovering all heat imparted to the air, and, in consequence, no sufficient provision of heating apparatus had been made. It having been found impossible to produce what, in effect, would have been a perpetual motion, the respirator had been discarded entirely, and was even now looked upon with great suspicion by engineers and men of science. Mr. Siemens had, however, no doubt that its real merits to recover heat that could not practically be converted by one single operation into mechanical effect, would be better appreciated. The rapidity with which the temperature of a volume of steam was raised from 250° to 650° Fahr. by means of a respirator, was indicated by the fact that he had obtained with his engines a velocity of 150 revolutions per minute. The single action of heating the steam occupied only a quarter the time of the entire revolution of the engine, and it followed that it was accomplished in one-tenth part of a second. But, in explanation of this phenomenon, it was contended that the transmitting of a given amount of heat from a hotter to a cooler body, was proportionate to the heating surface multiplied by the time occupied, and that the latter factor might be reduced *ad libitum*, by increasing the former proportionately. The air-engines of Stirling and Ericsson had failed also, because their heated cylinders had been rapidly destroyed by the fire: but the cause for this was, that an insufficient extent of

heating surface had been provided; and it was well known that even a steam boiler would be rapidly destroyed under such circumstances. Mr. Siemens was led by his own experience to believe that his heating vessels would last certainly from three to five years, and being only a piece of rough casting, that could be replaced in a few hours, and at a cost below that of a slight boiler repair, he considered that he had practically solved the difficulty arising from high temperature. It was, however, important to add, that all the working parts of his engine were at the temperature of saturated steam, and therefore in the same condition as ordinary steam engines; whereas in Ericsson's engine, the hot air had entered the working cylinder. In surrounding the heating vessel with the boiler, an excessive accumulation of heat was prevented from taking place, and the pressure of the steam in the boiler became the true index to the engine-driver of the temperature of the heating vessel. Another essential property of the heating vessel was, that all its parts should be free to expand by heat without straining other parts, which was accomplished by a free suspension, and by undulating its surface. Lastly, it should be massive, to stand the fire with impunity; for iron was, strictly speaking, a combustible material. The pyropherus, or finely divided metallic iron, took fire spontaneously on exposure to the atmosphere; a chip of iron was ignited in flying through the flame of a candle; an iron tea-kettle was destroyed by exposing it (unfilled with water) to a kitchen fire; whereas, in forging a crank-shaft, the solid mass of iron withstands the white heat of the forge-fire for several weeks without deteriorating. A heating vessel, properly constructed and protected, might be heated with safety to 700° Fahr., at which temperature it would be almost as able to resist pressure as at the ordinary temperature of the atmosphere, the point of maximum strength of iron being at 550° Fahr., as had been proved by experiments made for the Franklin Institution. The construction of a heating vessel combining these desiderata was of paramount importance for the success of Mr. Siemens's engine, and had not been accomplished without combatting against considerable practical difficulty.

Although heat may be entirely converted into mechanical effect, it would nevertheless be impossible to construct an engine capable of fulfilling this condition without causing at the same time a portion of heat to be transferred from a hotter to a cooler body, and which must ultimately be discharged. This necessity has been generally proved, and in a very elegant manner, by Professor Clausius, of Zurich, and implies at least the partial truth of "Carnot's theory." In the "regenerative steam engine," provision had been made for absorbing this quantity of heat, arising in this case from the circumstance that the saturated steam enters the respirator in a state of greatest density or compression, and returns through it (expanding into the regenerative cylinder,) at a gradually diminishing density, although the temperature of the extreme edges of the respirator remains proportionate to the condensing point of the steam of greatest density, by providing water chambers about the cover of the working cylinder, and around the regenerative cylinder, which are in communication with the steam boiler. The heat absorbed from

the slightly superheated steam is thus rendered useful to generate fresh steam.

Objection had been raised by casual observers against the regenerative steam engine, on account of its apparant similarity in principle to the "air engines" of Stirling and Ericsson, implying similar sources of failure. The apparent similarity in principle arose from the circumstance that both Stirling and Ericsson, as well as himself, had employed the respirator and high temperatures; but these were subordinate means or appliances, that might be resorted to in carrying out a correct as well as an erroneous principle.

In the winter of 1852-53, when Ericsson was engaged upon his gigantic experiment in America, the speaker had had occasion to read a paper to the Institution of Civil Engineers, entitled, "On the Conversion of Heat into Mechanical Effect," wherein he had endeavored to set forth the causes of probable failure of that experiment, and to guard against a sweeping condemnation on that account of some of the means Ericsson had employed.

According to the dynamic theory of heat, the elastic medium employed in a perfect caloric engine was a matter of indifference, and air had been resorted to because it was perfectly elastic, and always at hand. In practice, however, the elastic medium employed was a matter of very great importance, and he (Mr. Siemens) had given the decided preference to steam, and for the following reasons:—

1. The co-efficient of expansion of saturated steam by heat exceeded that of air in the proportion of about 3: 2, but decreased with an increase of temperature. This was not in accordance with the established rule by Guy Lussac and Dalton, but was the result of his own experiments (described in a paper, "on the expansion of steam, and the total heat of steam," communicated to the Institution of Mechanical Engineers, in 1850), and had been borne out by his practical experience on a large scale. Mr. Siemens had been first induced to undertake these experiments in consequence of an observation by Faraday, that the elastic force of the more permanent vapors gave way rapidly, when by abstraction of heat their point of condensation was nearly obtained. He conceived that gases and vapors would expand equally by heat, when compared, not indeed at the same temperature, but at temperatures equally removed from their points of condensation.

2. When saturated steam was compressed (within the regenerative cylinder), its temperature would not rise considerably (as the fire-syringe evinced in respect of air), because Regnault had proved that the total heat of steam increased with its density, and consequently the heat generated in compression was required by the denser steam to prevent its actual condensation. Without this fortunate circumstance, the steam would be heated already by compression to such an extent that it would be difficult indeed to double its elastic force by the further addition of heat in the respirator.

3. Steam exercised no chemical action upon the metal of the heating vessel and respirator, because the oxygen it contained was engaged by hydrogen, which latter had the stronger affinity for it until a white heat

was reached; whereas the free oxygen of atmospheric air attacked iron and brass at much lower temperatures.

4. The specific gravity of steam was only about one-half that of atmospheric air at equal temperature and pressure; moreover, it was a far better conductor of heat, and both circumstances qualified it for rapid respirative action.

5. The fresh steam required for starting and sustaining the power of the engine was generated by heat that would otherwise be lost. No air-pumps, &c., were required, and the management of the engine became as simple as that of an ordinary high-pressure steam engine.

In conclusion, it was stated that at present there were several regenerative engines in constant practical operation, in this country (at the works of Messrs. Newall & Co., at Gateshead), in France, and in Germany, varying from five to forty horse-power, which had proved the practicability of the principle involved, although they were still capable of improvement. Several other engines were now in course of construction at establishments celebrated for precision of execution, and with the advantage of Mr. Siemens's increased experience in designing them. He had been fortunate to meet with men of intelligence and enterprise, lately joined together in a public company, whose co-operation insured a more rapid development of his invention than individual effort could produce. The benefit he had hoped to derive from his discourse, incomplete as it necessarily was, would be realized, if those men, eminent in science, whom he saw around him, would accept his labors as an earnest towards the practical realization of the dynamical theory of heat, and hasten its triumphs by their own researches. It was impossible to over-estimate the benefits that mankind would derive from a motive force at one-third or one-fourth part the cost and incumbrance of the present steam engine. The total consumption of coal would certainly not diminish; but our powers of locomotion and production would be increased to an extent difficult to conceive, tending to relieve men from every kind of bodily toil, and hasten the advent of the hoped-for period of general enlightenment and comfort.

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*Economic Working of Steam.**

Sir—Having observed for some years, that the increase of pressure in the condenser of a steam engine does not decrease its economy in the same ratio that obtains between pressure in condenser and pressure on piston, I arrived at the conclusion that it was possible to find the maximum pressure in condenser that would give the maximum of economy when the mean effective pressure on the piston was given, the feed-water being forced into the boiler at the temperature due to pressure in condenser.

* From the Lond. Civ. Eng. and Arch. Journ., August, 1856.

The two following statements are true when taken independent of each other.

1st. The nearer we approach to a pure vacuum in the condenser, the less will be the fuel used to drive the engine.

2d. The hotter the feed-water enters the boiler, the less will be the fuel required to convert that water into steam.

In the first, the amount of fuel used decreases with the decrease of pressure in the condenser; in the second, the amount of fuel used decreases with the increase of temperature of the water in the condenser, when said water is used to feed the boiler. Hence, there is a temperature and pressure in the condenser at which the greatest economical effect is produced.

In order to ascertain this, let T = total heat of steam in boiler; t = temperature of steam in condenser; P = mean pressure of steam acting upon a piston in pounds per square inch; p = pressure of steam in the condenser in pounds per square inch.

Then the ratio of effect will be for pressure $\frac{p}{P}$, and that for temperature $\frac{t}{T}$; the maximum of economy will be obtained when

$$\frac{p}{P} = \frac{t}{T} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

But t and p are unknown, whilst P and T are known. And in order to find t and p, another equation containing them must be produced; this is furnished by Southern's formula for pressures less than the atmosphere—namely:

$$p = 1{\cdot}04948 + \left(\frac{51{\cdot}3 + t}{155{\cdot}7256}\right)^{5{\cdot}13} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$\text{Also } p = \frac{t\,P}{T} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

by transposing equation (1). Therefore,

$$\frac{t\,P}{T} = {\cdot}04948 + \left(\frac{51{\cdot}3 + t}{155{\cdot}7256}\right)^{5{\cdot}13}$$

And since the temperature in the condenser will not be much affected by the quantity ·04948, it may be neglected; then by transposition we get

$$\frac{P}{T} = \left(\frac{51{\cdot}3 + t}{155{\cdot}7256}\right)^{5{\cdot}13} \div t.$$

Giving this last equation a logarithmic form, we have

log. P — log. T = 5·13 [log. (51·3+t) — log. 155·7256] — log. t. From which the value of t may be found for any value of P, by any of the methods of approximation. Double Position is perhaps the simplest plan, and is the one I have adopted in order to get the values shown in the following tables.

By assuming any value for P, that of T is found by the formula given by Regnault, viz:

$$(t' = 32^\circ)\ {\cdot}305 + 1123{\cdot}7 = T,$$

where t is the temperature Fahrenheit corresponding to the pressure P'

of the steam in the boiler including the atmosphere. When t is found, p may be found by Equation (3).

The following table shows the temperature and pressure in the condenser when P varies from 30 lbs. to 6 lbs. upon the square inch. If the pressure in the boiler be increased to 70 lbs. or decreased to 20 lbs., the values of t and p will not be much changed, since T varies very little from the value in the table for these pressures.

Pressure in boiler = 40 lbs. above the atmosphere $\therefore$ T = 1202° Fah.			Most economical pressure in condenser by Indicator.
P	t	p	15—p.
lbs.	Temperature Fah.	lbs.	
30	150·5	3·72	11·28
28	146·5	3·36	11·63
26	141·9	3·02	11·98
25	140·6	2·92	12·1
24	138·6	2·73	12·27
22	134·8	2·48	12·52
20	129·6	2·14	12·86
18	125·6	1·9	13·1
16	119·	1·64	13·36
14	113·	1·38	13·62
12	105·	1·09	13·96
10	98·7	·89	14·11
8	92·5	·73	14·27
6	84·	·57	14·43

This table shows that as the mean pressure on the piston increases, the pressure in the condenser increases also, when the economical effect is a maximum; and if we increase the mean pressure still further, we soon find that condensers with pressures equal to and above the atmosphere may be used with advantage, as shown by the next table.

Pressure in boiler=55 lbs. including the atmosphere $\therefore$ T=1202° Fah.			Pressure in boiler=85lbs., including the atmosphere $\therefore$ T = 1211° Fah.		
P	t	p	P	t	p
40	166	5·52	60	189	9·36
50	179	7·44	70	199	11·5
			80	208	13·74
			84·5	212	14·8

The above table shows that it is not essential that an air pump and condenser of the present construction is required in order to obtain the most economical result.

If condensation near the atmospheric pressure be adopted, the temperature of the feed water may be 212° Fah., which will dispense with the air-pump altogether, at the same time saving a great amount of un-

necessary power, and consequently a great amount of fuel. And since the steam used will be of a higher pressure, the diameter of the cylinder may be much reduced, and considerable economy will be the result.

Steam of 37 lbs., including atmosphere, is 6 per cent. cheaper than steam of atmospheric pressure.

Steam of	42 lbs.	is 7	per cent. cheaper.
"	48 lbs.	8	" "
"	55 lbs.	9	" "
"	63 lbs.	10	" "
"	70 lbs.	11	" "
"	79 lbs.	12	" "
"	87 lbs.	13	" "
"	100 lbs.	14	" "
"	110 lbs.	15	" "
"	120 lbs.	16	" "

By dispensing with the air pump, and using high steam, independent of expansion, a saving of about 15 per cent. may be expected. Where new steam engines are to be erected, a very great saving in the first cost will be obtained, and a great amount of space saved.

THOMAS BALDWIN, C. E.

Corn Market Buildings, Bury, Lancashire, July 3, 1856.

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*On the Construction of Packing Rings for Pistons.** By Mr. JAMES RAMSBOTTOM.

The writer of the present paper—having invented a few years ago a metallic piston, the packing of which is forced against the working surface of the cylinder by its own elasticity, and owing to its being comparatively slender in cross section, had to be left about 10 per cent. larger in diameter than the block of the piston, to give the requisite pressure for preventing the passage of steam—found, that when such packing was made of a circular figure before being compressed, it was invariably worn more rapidly at the joint, and at the part opposite the joint, than at the intermediate parts. It is very natural that this should be the case, and it has been the practice with many engineers, when using packing rings which are pressed against the cylinder by their own elasticity alone, to make the part opposite the joint, where there is clearly the most strain, stronger than any other; each half being tapered off to the joint: this has not however been done by any positive rule.

It was taken for granted that the unequal wear above referred to was owing to the pressure against the cylinder being unequal in different parts of the ring; and as the packing rings used by the writer are made of wire or drawn rods, and consequently uniform in thickness, it was found impracticable to ensure this equable pressure by tapering the ring; but as this uniform pressure can be obtained by making the packing ring truly circular in figure, but unequal in thickness, it occurred to the writer, inasmuch as the rings which he employs are bent and not turned, that the same end might be gained, by conversely making the ring equal in strength of material, but unequal in figure; or in other words, that a ring

* From Newton's Lond. Journ., August, 1856.

might be made of such a shape, that although uniform in cross section, it would press equally against the working surface of the cylinder all round.

It may be possible to determine geometrically the form of ring required, but the writer preferred to solve the question in a practical manner by the following method:—A ring was first bent truly circular in shape, and of a diameter exactly equal to that of the piston for which it was intended—the ends just touching at the joint, but without pressure: this ring was then placed upon a circular table, and concentric therewith; and a number of strings, say twenty-four in all, were attached at equal distances apart round the circumference, and passed over the same number of small pulleys which were fixed at equal distances round the edge of the table. To these strings were attached equal weights, which, acting upon equal portions of the circumference of the circular ring, brought it into an oblong shape. The writer then conceived that if a true circle were brought into this shape, when subjected to equal radial forces acting upon equal portions of its circumference, another ring bent to the figure so obtained would conversely be brought to a truly circular shape by the application of equal forces acting in the opposite direction, that is, towards the centre instead of from it; and practice has proved that such a conclusion was correct; for a ring so bent is found to wear equally throughout, and to last much longer than those originally made circular in figure.

In trying these experiments, an important fact has been accidentally discovered, namely, that the force required to keep the packing in contact with the working surface of the cylinder, even at pressures exceeding 100 lbs. per square inch, is much less than is generally supposed. It has been argued that the pressure per square inch on the rubbing surface must be at least equal to the steam pressure which has to be resisted; but so far from this being the case, experiment has led the writer to the conclusion, that as respects the pistons of locomotive engines, this need not exceed 3½ pounds per square inch of rubbing surface, even when the rings are new and exerting their maximum force; and as these packing rings are practically steam-tight until half worn, it follows that the average pressure upon the working surface of the cylinder does not amount to three lbs. per square inch. This slight pressure, taken in connexion with the small amount of rubbing surface, is sufficient to account for the satisfactory performance of this description of packing.

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The apparatus for ascertaining the correct curve for the piston rings was shown in operation; and two sets of rings that had been curved on the improved plan, and had worked in two pairs of pistons for 12,694 and 10,012 miles respectively, were exhibited, showing a very uniform wear of the rings throughout their length.

Mr. Joy observed that he had found a long and light elasticity was the right plan for the packing of a piston; and the results of his experience confirmed the statement in the paper, as to a very light pressure of the packing rings, not exceeding three or four lbs. per square inch upon the cylinder surface, being quite sufficient to keep them steam-tight if free in their action; and the consequence was, a very considerable

saving in the friction of the pistons over the ordinary kinds of metallic packing.

The Chairman said his object in the paper had been merely to show the practical way in which the practical difficulty had been surmounted. The result of the improved form of packing rings had been very satisfactory; and about double the mileage was now obtained from the same thickness of rings, compared to the former results, owing to their wear being nearly uniform throughout their whole length.

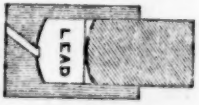
For the Journal of the Franklin Institute.

On Neutralizing the Force of Collisions of Locomotive Engines.

I saw a communication in the "*Ledger*" a few weeks since, from a gentleman, whose name I have unfortunately forgotten, on the subject of neutralizing the force of collisions of locomotive engines.

He instanced the effect of introducing heated metal under a forge hammer, which would prevent the destructive action of the hammer upon the anvil under blows of any force; and proposed the interposition of some material which would pack or crush to receive the shock of the collision of two locomotives.

This suggested to me the idea of forming bumpers for locomotives, upon the principle of the reverse action of hydrostatic presses, and substituting cold lead for the water. Upon this plan, any desired amount of *yielding* resistance can be obtained, by increasing the diameter of the plunger in proportion to the diameter of the aperture through which the cold lead would be forced by the action of the collision upon the plungers, like meat through a "sausage stuffer." The interior of the bumper would be a hollow cylinder, terminating in a cone or portion of a sphere, with a small aperture; and the plunger would be made exactly to fit it.



The rounded or conical end of the plunger would first impinge upon the flat surface of the lead, in the cylinder, and operate like a spring, gradually increasing the resistance up to the maximum, when the lead would commence passing through the aperture, and continue a *yielding* resistance at that pressure, until the whole of it would be expelled from the cylinder, should the momentum of the collision not be previously balanced.

ERSKINE HAZARD.

Philadelphia, August 26, 1856.

AMERICAN PATENTS.

List of American Patents which issued from July 29th, to August 26th, 1856, (inclusive,) with Exemplifications.

JULY 29.

190. For an *Improvement in Pegging Jacks;* Alfred Bailey, Amesbury, Mass.

Claim.—"1st, The application of a spiral or other spring, to hold the last firmly in its place, and at the same time, allow the head pieces to be put in any desired position, without re-adjusting the last or spring. 2d, The arrangement by which the vertical head may be turned vertically above the axis upon which it turns horizontally."

191. For an *Improvement in Portable Folding Tables;* C. D. Barnitz, Baltimore, Md.

Claim.—"The movable braces and supports, which, when in a horizontal position, brace firmly the legs in an upright position, and also give support to the lids, and when turned into a vertical position, permit the legs to close in against the under surface of the table."

192. For an *Improvement in Raking Apparatus of Corn and Cane Harvesters;* John W. Batson, Triadelphia, Md., Assignor to self and Martin H. Batson, Maryland.

Claim.—"In combination with the endless rake belts, passing under and over the platform, and thence over the pulleys, the shield placed between them, when said shield receives the corn or cane from the rakes, at their highest elevation, and conveys it into a wagon, or other receptacle alongside."

193. For an *Improvement in the Cutting Apparatus of Corn and Cane Planters;* John W. Batson, Triadelphia, Md., Assignor to self and Martin H. Batson, Md.

Claim.—"The double angle V shaped cutters, composed of strips and under supports. Also, hanging said cutters to a pivoted bar, so that they may be raised up out of cutting position, when the machine is drawn through the stubble, to prevent their catching against the previously cut corn or cane."

194. For an *Improvement in Machines for Sawing Stone in Taper Form;* H. J. Behrens, City of New York.

Claim.—"Giving to a saw, placed in a line inclined to the line of motion of the saw frame, a lateral motion independent of the motion of the frame, or at right angles to the line of motion thereof."

195. For an *Improvement in Apparatus for Solar Salt Evaporation;* J. T. Boynton, Syracuse, New York.

Claim.—"The use and application of the covers of the salt vats, for the evaporation of salt water by solar influence."

196. For an *Improvement in Churns;* W. H. Burnham and B. Hibbard, Cortlandt, New York.

Claim.—"Our improved churn dasher, composed of two independent frames, combined with each other and with the operating lever."

197. For an *Improvement in Metal Planers;* E. C. Cleveland, Worcester, Mass.

Claim.—"The friction box attached to the shaft, and provided with adjustable dogs; the box being connected with the shaft by the gearing, and operating conjointly with the gearing and pawl on the shaft, and the arm which projects over the box."

198. For an *Improvement in Sawing Machinery;* A. S. T. Copeland, Pittsburgh, Pa.

Claim.—"The saw-heads and saw-strainers, and the combination of said saw-heads and strainers with the screw-nuts and screws. Also, attaching of saw-heads to pitman. Also, the combination of belt reversers with the mechanism for starting and stopping saws, and reversing pitman and circular saw shafts. Also, by reversers."

199. For an *Improvement in Harness for Weaving Seamless Bags;* Algernon S. Cole, Windham, Maine.

Claim.—"The application to weavers' harness, the addition of one row of heddle eyes, making two rows instead of one, upon each leaf of harness."

200. For an *Improved Shutter Operator;* James R. Creighton, Boston, Mass.

Claim.—"The attachment of the serrated tumbler catch to the slide, said catch meshing or interlocking with a similarly serrated or toothed surface, opposed on the side of the slide box, or frame box, in combination with the square extension rod and guides, by which I am enabled to operate the outside blinds or shutters of a house from the inside of the same, and to secure said blinds or shutters in any position, without the liability of their dislodgement from the outside, unless by the exercise of unusual violence."

201. For an *Improved Fountain Pen;* Austin G. Day, Seymour, Connecticut.

Claim.—"The sliding feed tube, having an aperture near its upper end, through which the ink flows, when the pen is in use; the aperture being closed, and the ink excluded from the feeding tube, by drawing it downwards into the lower end of the ink chamber. Also, the combination of the air hole or vent with the sliding feeding tube, the enlarged end of which closes the vent hole when the feeding tube is drawn down to stop the flow of ink to the pen."

202. For an *Improvement in Pyrogenous Lubricating Oils;* Samuel Downer and Joshua Merrill, Boston, Massachusetts.

Claim.—"The improvement of dissolving elastic bitumens, caoutchouc, or gutta percha, in the pyrogenic oils, used as lubricators."

203. For an *Improvement in Machines for Sawing Marble;* Lewis S. Fisher, Waynesboro', Pennsylvania.

Claim.—"Operating the saws by racks and cog wheel, in combination with the guides."

204. For an *Improvement in Fore and Aft Rig of Vessels;* George W. Gerau, Brooklyn, New York.

Claim.—"Constructing the mainsail, and having the lower end of the topsail attached to the outer end of the boom."

205. For an *Improvement in Sugar Evaporators;* Samuel H. Gilman, New Orleans, Louisiana.

Claim.—"The combination of the long kettle with the train of kettles; the pipe, the serpentine channel, and the fire flues. Also, the combination of the troughs with the train of kettles and the long kettle."

206. For an *Improvement in Bake Ovens;* John P. Hayes, Philadelphia, Penna.

Claim.—"The heating flues, arranged so as to cause the products of combustion to pass from the fire chamber below, first into the lower flue; thence behind its position, and out; thence, into the next flue above, and out; and so on through the successive flues which may be above, to the escape flue; the said flues being arranged on the two sides of the casing, and divided by the partition, and the products of combustion being directed thereby; together with the the partition plates in the wall."

207. For *Improved Devices in Stave Machinery;* Charles Hoyt, West Aurora, Illinois.

Claim.—"1st, Adjusting the staves in line with the feed rollers and jaws, by means of the sliding bed or plate, and laterally sliding plates. 2d, The feeding block, when operated by the spring, lever, and eccentric."

208. For an *Improvement in Steam Boiler Furnaces;* E. T. Ingalls, Haverhill, Mass.

Claim.—"The improvement in steam boilers, which consists in arranging a fire pot of sufficient depth to contain a large quantity of fuel, within or about and underneath the boiler, placed concentrically therewith, in such a manner, as to keep the fuel which is in contact with the lower part of the furnace, in a full state of combustion always."

209. For an *Improved Method of "Patching" Rifle Shot;* Ralph H. Isham, Greenwich, Connecticut.

Claim.—"The use of a leaden ball or bullet, of any desirable form, with a metallic case, or coating of brass or other firm metal, in whole or in part, whether plated, washed, or galvanized, or by whatever mechanical device the coating or partial coating may be effected for the use and objects of this invention."

210. For an *Improvement in Corn Planters;* James D. Jeffers, Joseph Sparks, and John H. Jeffers, Philadelphia, Pennsylvania.

Claim.—"1st, The moving, inclined planes, and spring, when constructed and combined, so as to operate together within the grain adjusting recesses. 2d, The stationary inclined planes, when operating in combination with the said recesses."

211. For an *Improved Clamp for Plumbers;* F. R. Langwith, City of New York.

Claim.—"The combination and arrangement of the clamp box, the clamping levers (when either is used), and, also, in combination therewith, the screws for adjusting the cock in a proper position, during the process of soldering with the main pipe."

212. For an *Improved Portable Printing Press;* Samuel W. Lowe, Philadelphia, Pa.

Claim.—"1st, The adjusting of the conical roller by means of the screw. 2d, The radiating lever, with its conical roller, in combination with the tympan and its spring."

213. For an *Improved Stave Machine;* John McMurtry, Fayette County, Kentucky.

Claim.—"The combination of the endless chain, or its equivalent, with the undulating bed or bearing, and the combination of these two devices with the planes for dressing the outer surface, and beveling the two edges to suit any size cask required. Also, the obtuse joint in the endless chain, at the carrying wheel."

214. For an *Improved Method of Inserting Faucets into Fluids under Pressure;* Patrick Mihan, Boston, Massachusetts.

Claim.—"The faucet receiver, as composed of the socket tube; and the perforated thimble, applied together by means of screws, and operated by the action of the faucets."

215. For an *Improvement in Hand Seed Planters;* A. C. Miller, Morgantown, Va.

Claim.—"In combination with the reciprocating agitators, the stationary but adjustable seed bar, with its wedge-shaped openings, and inclined sides, for the purpose of sowing seed broadcast, and adjusting the machine to the quantity or kind of seeds to be sown."

216. For an *Improvement in Soap Boiling Apparatus;* Campbell Morfit, Baltimore, Maryland.

Claim.—"The combination of the hollow shaft and tubular arms as a mixing, stirring, and heating twirl for 'dry' steam, either in open or closed vessels."

217. For an *Improvement in Potato Planters;* John Moore, Quincy Point, Mass.

Claim.—"Arranging and combining with the chambered cylinder and its spring guards, and so as to operate therewith a series of scrapers."

218. For an *Improvement in Coal Scuttles;* James Myers, Jr., City of New York.

Claim.—"Constructing the scuttle with a cast iron chambered or dish-shaped bottom, having a supporting flanch, in conjunction with and attached to the sheet or wrought iron sides of the body of the scuttle."

219. For an *Improvement in Knitting Machines;* John Nesmith, Lowell, Mass.

Claim.—"The lowering or raising the ends of the needles which receive the threads, so that the thread will not enter the hooks of the needles when out of their working line, as the carrier passes them, while the other ends of the needles remain connected with the mechanical arrangement used for pushing them forward and drawing them back, to form the stitch on their lines. Also, the slides, or their mechanical equivalents, for taking the needles out of the work for narrowing the fabric, and bringing them back into the work for widening the fabric. Also, the metallic rests or guards, or their equivalents, for constantly keeping a number of the needles in their working line. Also, the connexion of a registering or measuring apparatus, with the moving parts of my machine, for the purpose of bringing into use and taking out of use, the requisite needles at the proper time of shaping the fabric, and for severing the thread when the work is done, and stopping the machine when required. Also, the arrangement and movement of the finned bar, or its mechanical equivalent, to aid in forming the stitch. Also, its movement backward to uncover the ends of the needles, for putting on the new fabric."

220. For an *Improved Printing Press;* Thomas and Alfred Parkes, Brooklyn, N. Y.

Claim.—"1st, The cylinder, having flat surfaces on its periphery to receive the forms,

in combination with the printing cylinders, placed in sliding bearings. 2d, The reciprocating shafts with the tapes, whereby the two printing cylinders are fed from one feed board, and the sheets therefrom, when printed on both sides, deposited upon one and the same fly board. 3d, The sliding frame, whereby the motion of the belt is reversed at the proper time, and also stopped at proper intervals; and the shaft raised and lowered for the purpose of reversing the movement of the sheets, and causing them to be printed on both sides."

221. For an *Improvement in Sawing Machines;* T. T. Prosser, Oconomowock, Wis.

Claim.—"The levers, pivoted or attached to the upright; the saw being placed at one end of the levers, and the levers adjusted by the bars and set screws at the opposite end."

222. For an *Improvement in Gutta Percha Apparatus for Covering Wire;* James Reynolds, City of New York.

Claim.—"1st, Providing the cylinder, or other vessel in which the gutta percha is submitted to the pressure, with a connexion to an air pump, or other suitable exhausting apparatus. 2d, The arrangement of the die and core or core piece, transversely to the direction in which works the piston or other device for producing the pressure. 3d, Providing the stomach, which contains the die, with a variable escape opening. 4th, The continuously revolving water trough, arranged relatively to the die."

223. For a *Pick-Pocket Detector;* Solomon W. Ruggles, Fitchburgh, Massachusetts.

Claim.—"Suspending the alarm detector, or instrument proper, including the case and its work parts, by the cord or chain, from or through the spring barrel, for alternate operation of the cord and bell-hammer by said barrel, in relation to the case."

224. For *Improved Devices in Carving Wood;* Nelson Ruger, West Farms, N. Y.

Claim.—"1st, The cutters, in combination with the bars, having arms attached to them—the arms having bars pivoted or jointed to their outer ends, to which the cutters and tracer are attached. 2d, The bar placed on a rod, which is attached horizontally to the vertical bar; the ends of the bar fitting between the arms."

225. For an *Improvement in Smut Machines;* G. H. Starbuck and L. D. Gilman, Troy, New York.

Claim.—"The combination of the screen, plate, funnels, and disk, with spike attached, when said plates are attached to the shaft, and fitted within the case or shell."

226. For an *Improvement in Machinery for Forming Hat Bodies;* Alva B. Taylor, Newark, New Jersey.

Claim.—"The combination of a perforated cone picking apparatus and feeding apparatus. The combination with a main picking cylinder, of a secondary picking cylinder. The pyramidal draft box, in combination with a fan case for generating the currents of air.

227. For an *Improvement in Ox Yokes;* Miron Smith, Sandisfield, Mass.

Claim.—"The adjustable fulcrum block, in combination with the bow slides."

228. For an *Improved Method of Turning Ellipsoidal Forms;* G. W. Walton and H. Edgarton, Wilmington, Delaware.

Claim.—"The feed rollers and expanding cutters—one or more, attached or fitted to the hollow shaft."

229. For an *Improved Machine for Manufacturing Spools;* Augustus D. Waymoth, Fitchburgh, Massachusetts.

Claim.—"Combining the rounding, severing, and body cutters, with a carriage made to slide between the chuck and boring carriage, and in line with the latter, and so as to be moved toward the chuck by the boring carriage, while it is moved toward the work. Also, arranging the body and severing cutters, and combining them with the cutter carriage, by means of a turning holder, whereby the said cutters may be made to operate and put in operation."

230. For an *Improved Mode of Hanging Window Sash;* Cromwell P. Weaver, Philadelphia, Pennsylvania.

Claim.—"The employment in connexion with window frames and sashes, of the sliding bars."

231. For an *Improvement in Apparatus for Purifying White Oxide of Zinc;* Joseph Wharton, Philadelphia, Pennsylvania.

Claim.—"Cooling white oxide of zinc, and separating it from impurities, by causing the products of the furnaces to impinge successively upon a surface of water."

232. For an *Improvement in Clover Seed Harvesters;* C. B. Wheeler and A. Bascom, Steuben, Ohio.

Claim.—"The reel and cutters or teeth, placed within the sliding or adjustable frame, in combination with the endless apron."

233. For an *Improvement in Sad-iron Heaters;* Benjamin F. Wheelock, Mayville, Wisconsin.

Claim.—"The use or application of the chains, in combination with the table and lids, made to balance on the ears."

234. For an *Improvement in Machines for Binding Grain, &c.;* Washington F. Pagett, Stone Bridge, Virginia.

Claim.—"1st, The way, in combination with the slide, or its equivalent. 2d, The band, in connexion with the way and slide."

235. For an *Improvement in Machines for Cutting out Soles of Boots and Shoes;* James W. Wilder, Boston, Massachusetts.

Claim.—"Arranging and vibrating the knives around the cutters."

236. For an *Improvement in Apparatus for Smoking Meats;* John Wright, Wilmington, Delaware.

Claim.—"The application to furnaces of smoke houses, a back plate of iron or other incombustible material, forming an air chamber which will increase the draft of the furnace, and prevent any smoke from being wasted or lost, and also the application of inclined flues made of brick, iron, earthenware, or any other incombustible material—together with the smoke spreader, for the purpose of smoking meats, &c., the furnaces being upon the outside of the building."

237. For an *Improvement in Cultivators;* Jacob Zimerman, Oswego, Illinois.

Claim.—"The revolving rake and clearer, in combination with the series of elastic cutters and flat cutters."

238. For an *Improvement in Moulds for Hollow Projectiles;* Ethan Allen, Worcester, Massachusetts.

Claim.—"Cutting off the sprue, by means of a cutter working on the curve of the inner surface of the ball, so as to leave the ball smooth and symmetrical."

239. For an *Improvement in Flour Bolts;* S. C. Mendenhall and J. Conner, Richmond, Indiana.

Claim.—"The manner of varying the action of the revolving brushes, by giving to the brush bars, any backward or forward regular set on the radial arms or bosses, which carry the brush bars, in relation to the run or travel of the same within the screen cylinder, by means of the links connecting the inclined pivots or rods of the brush bars with a turning ring, arranged to revolve together with the brush shaft, but made capable of circular adjustment thereon. 2d, In combination with the radial expansion and contraction of the brush bars and brushes, within or against the screen cylinder for graduating the rub of the brush, giving any varied annular set backward or forward to such graduated rub, by so connecting the brush bars with the devices which effect the expansion or contraction as to admit of a variable inclined set or position, in relation to the run being given the said brush bars and brushes, to adjust or improve the action of said radially graduated rub."

240. For an *Improved Face-plate for Locks;* Thos. B. Atterbury and William Warwick, Assignors to Warwick, Atterbury & Co., Pittsburgh, Pennsylvania.

Claim.—"The separate or distinct guards or face-plate, of such a form in relation to case or skeleton frame of a lock or other fastening, that it may be put on either of the two sides of the said case or frame, whereby either of the sides can be made the face of the said lock or fastening."

241. For an *Improvement in Bee Hives;* J. S. Brown, Washington, D. C., Assignor to Joseph Kent, Baltimore, Maryland.

Claim.—"The peculiar construction of the drawer and its arrangement, in combina-

tion with the basement and bottom of the hive, so as to be reversible in position, and to serve the several purposes of a controllable ventilator, filth receptacle, with moth trap and feeding chamber."

212. For an *Improvement in Chimney Dampers;* Theodore F. Engelbrecht, Assignor to self and Thomas C. Nye, City of New York.

Claim.—"The supplemental perforations, consisting of the suspended conical deflectors."

213. For an *Improved Faucet;* Joseph Goodridge, Assignor to the Boston Faucet Company, Boston, Massachusetts.

Claim.—"So combining with the valve and its stem the dove-tailed recess, the expander, and a shoulder and screws, or the equivalents thereof, whereby the foot of the spring packing may be fastened into the valve."

214. For an *Improvement in Whiffle-Trees;* George Kenny, Milford, N. H., Assignor to self and George N. Davis, Boston, Massachusetts.

Claim.—"The combination of rubber washers with the whiffle-tree and about the king bolt, and the boxes arranged with the same, so as to protect the rubber and boxes from the entrance of water, dirt, &c., and thereby preventing the wear of the parts."

215. For an *Improvement in Whiffle-Trees;* George Kenny, Milford, N. H., Assignor to self and George N. Davis, Boston, Massachusetts.

Claim.—"The combination of rubber about the bolt on which the whiffle-tree turns, within the cylindrical strap and between the braces, so that it may be compressed, and thereby operate as a spring as well as serve to keep out the dirt, and prevent the wear and noise."

216. For an *Improvement in Pegging Jacks;* Alfred Swingle, Assignor to Elmer Townsend, Boston, Massachusetts.

Claim.—"The arrangement and application of the trammel or grooved cross, its slide bar and guide pins, the last holder and its sustaining arm, the same enabling advantages or new and useful effects to be attained."

247. For an *Improved Method of Operating Gates for Water Wheels;* John C. Shorey, Assignor to self and Augustus J. Webster, Rochester, N. H.

Claim.—"Applying the two gates to the wheel and flume, in manner and so as to operate with respect to the discharging spring and the wheel shaft."

ADDITIONAL IMPROVEMENTS.

1. For *Improved Protecting Bulwarks for War Vessels;* William Ballard, City of New York; patented Nov. 1, 1853; additional, dated July 1, 1856.

Claim.—"The pannels and stancheons as arranged in relation to the promenade deck and bulwarks of the vessel."

2. For an *Improvement in Looms;* James O. Leach, Ballston, New York; patented Oct. 30, 1855; additional, dated July 8, 1856.

Claim.—"The employment of two sets of cams, four in each set, constructed, shaped, and arranged in reference to each other, the same being movable to the right and left without changing their intervals, and in either position producing a tubular cloth, one set being arranged in reference to the other, so that the shift of the cams shall make the harness shift the warp, instantly carrying that part forming the upper web downward, and that forming the lower web upward, making at their crossing a firm single joint."

3. For an *Improved Method of Regulating Pumps by Wind Wheels;* Jacob W. Goodwin and Moses C. Hawkins, Edenborough, Pennsylvania; patented April 8, 1856; additional, dated July 15, 1856.

Claim.—"1st, Constructing the wind wheel so that the shaft will turn with it, together with the manner of braking or stopping the wheel when the water cistern is filled with water, by means of the hydrostatic bellows, and the lever, and the brake blocks. 2d, The construction of the friction wheel, in combination with the friction wheel and the brake."

4. For an *Improved Gas Heater;* William F. Shaw, Boston, Mass.; patented January 23, 1855; additional, dated July 22, 1856.

Claim.—"The arrangement of a separate or boiling chamber, that is, to or between the flue pipe and the reverberating dome or space."

RE-ISSUES FOR JULY, 1856.

1. For an *Improvement in Spirit Levels;* Sylvester S. Sherman, City of New York; patented July 19, 1853; re-issued July 1, 1856.

Claim.—"The spring catch to hold the level in place upon the square or ruler, in combination with the bearers, the latter being so formed in respect to the level, that when they are placed upon a horizontal line, the bubble will be in the middle of the glass, and thus a horizontal or vertical line may be ascertained from a ruler or from a square when said level is attached."

2. For an *Improvement in Securing Pinions, &c., of Watches in Lathes;* James M. Bottum, City of New York.; patented July 15, 1851; re-issued July 8, 1856.

Claim.—"The employment of adhesive cement for securing staffs and pinions of watches and like articles of small dimensions for lathe operations, in combination with a chuck having a female centre therein, either with or without the tube."

3. For an *Improvement in Grain and Grass Harvesters;* Eliakim B. Forbush, Buffalo, New York; patented July 20, 1852; re-issued July 8, 1856.

Claim.—"1st, Extending or widening out the guard finger. 2d, Dropping that part of the frame (herein called the clamp) down the guard. 3d, The mould board. 4th. The arrangement and combination of a right angled stanchion, made of wood or metal, with a pivoted motion on the frame work of the machine, and supporting upon its upright part a lever, made of wood or metal, with a pivoted motion on the said stanchion, (or post,) to which lever is attached a rake."

4. For an *Improvement in Sowing Machines;* Pierpont Seymour, East Bloomfield, N. York; patented May 7, 1845; re-issued July 15, 1856.

Claim.—"The manner in which I have combined the stirring rod or bar, with the dropping bar or vibrating bar, and in combination therewith the gauge rod with its index for regulating the amount of seed to be dropped. Also, the lever, with a movable pin or fulcrum operated by the zig-zag motion for working the vibrating rods, and regulating the quantity per acre to be sown by increasing or decreasing the motion of the vibrating rod."

5. For an *Improvement in Machinery for Filling Seine Needles;* H M. Glines, Assignor to J. M. and S. F. Stanton, Manchester, N. H., Assignors to P. Bennett, J. Kendrick & L. A. Cook, Providence, R. I.; patented October 2, 1855; re-issued July 15, 1856.

Claim.—"Imparting to the needle and to the arm the motions for carrying the twine, cord, or thread, into the eye of the needle, around the tongue, and then out of the eye."

6. For an *Improvement in Cotton Gins;* David G. Olmstead, Vicksburg, Miss., Assignee of R. A L. McCurdy, Sabine Parish, La.; patented June 26, 1855; re-issued July 15, 1856.

Claim.—"The revolving screen situated in the hopper or 'roll box.' Also, the revolving screen. Also, the spirally winged shaft, revolving within said screen."

7. For an *Improved Metallic Pen;* Adam W. Rapp, Philadelphia, Penna.; patented January 6, 1852; re-issued July 22, 1856.

Claim.—"Reducing or thinning the sides of the pen between the shoulder and split, whereby advantages are freely attained, and the metallic pen made to possess the qualities of the quill pen.

8. For an *Improved Machine for Raking and Loading Hay;* Joseph Smith, Condit, Ohio; patented June 3, 1856; re-issued July 22, 1856.

Claim.—"The combination of rake with spring, guard, plate, and fork."

9. For an *Improvement in Operating Valves in Direct Acting Steam Engines;* Wm. H. Guild and William F. Garrison, Brooklyn, New York; patented March 27, 1855; re-issued July 29, 1856.

Claim—"Giving to the valve the whole or part of the movement necessary to effect the change in the direction of the movement of the engine piston, by means of the steam acting upon a piston which is fitted to work perpendicularly to the valve in a cylinder, forming a part of the valve driver, or device employed to drive the valve, and is supported against the pressure of steam by a rocker, by which it is caused to operate on the valve driver."

DESIGNS FOR JULY, 1856.

1. For *the Base of Clock-case Fronts;* Nicholas Muller, City of New York; dated July 1, 1856.

   Claim.—"The male figure, dog, stumps, roots, leaf foliage, and blades of grass."

2. For *Clock-case Fronts;* Nicholas Muller, City of New York; dated July 1, 1856.

   Claim.—"The war trophies, foliage, and eagle."

3. For *Ornamental Fire Places;* John C. Macy, Cincinnati, Ohio; dated July 8, 1856.

   Claim.—"The configuration, &c., of the front plate and fender of grates.

4. For *Parlor Ovens;* Russell Wheeler and Stephen A. Baily, Utica, New York; dated July 8, 1856.

   Claim.—"The general design and configuration of the stove."

5. For *Box Stove Plates;* Winslow Ames, Nashua, N. H.; dated July 15, 1856.

   Claim.—"The combination, &c., of the ornamental figures and forms represented."

6. For *Cooking Stoves;* Joseph Hackett, Louisville, Ky.; dated July 29, 1856.

   Claim.—"The configuration and arrangement of the ornaments."

7. For *Clock Fronts;* J. and R. Shepherd, City of New York; dated July 29, 1856.

   Claim.—"The combination and arrangement of the several ornaments.

8. For *Cooking Stoves;* Benjamin Wardwell, Fall River, Mass., and Ephraim R. Barstow, Providence, R. I.; dated July 29, 1856.

   Claim.—"The form, configuration of the parts or ornaments."

AUGUST 5.

1. For an *Improved Fly Trap;* Samuel Arnold, Wilson County, Tennessee.

   Claim.—"The mechanical arrangement of box, jar, springs, lever, slides."

2. For an *Improved Weather Strip for Doors;* James H. Banta, Piermont, N. Y.

   Claim.—"The bar constructed with the T head, and fitted into the slot in plate. Also, in combination with said bar the double inclined latch."

3. For an *Improved Reel for Fishing Rods;* John A. Bailey, Jersey City, New Jersey, Assignor to John Warren, City of New York.

   Claim.—"The sliding crank, shaft, and spring, arranged so that the pinion and wheel may be placed in and out of gear as desired, and the reel connected with and disconnected from the shaft."

4. For an *Improved Mortising Machine;* Thomas R. Bailey, Lockport, New York.

   Claim.—"The mandrel fitted in bearings attached to sliding plates—one of the bearings being pivoted to the plate, and the other bearings allowed to slide on the other plate; the mandrel being vibrated laterally by the screw, worm-wheel, eccentric, pitman, and bent lever."

5. For an *Improvement in Spike Machines;* Moody Belknap, Boston, Mass.

   Claim.—"The improvement of making the movable knife with a rectangular recess."

6. For an *Improvement in Sewing Machines;* Sherburn C. Blodgett, Philadelphia, Pennsylvania.

   Claim.—"1st, The arrangement of the crimping notch in the shuttle, for the purpose of drawing the slack thread from the needle, and thus preventing the loop of thread from being taken up a second time. 2d, The employment of a series of pawls or drivers around the circumference of a discordal or circular shuttle, whereby the driving force is applied equally, or nearly so, through a considerable arc of the circumference of such shuttle. 3d, The mode of driving the disk shuttle at its circumference, by means of a hollow pulley or sleeve, revolving around a fixed shaft or axis. 4th, The mode of giving motion to the needle arm and feed rollers, by direct connexion with the same sleeve or revolving shaft to which the drivers are attached, which drive the disk shuttle. 5th, The arrangement of the cams and lever for operating the slide, in combination with the cam and arm for operating the pressure pad."

7. For an *Improvement in Sewing Machines;* Joseph Bond, Philadelphia, Penna.

Claim.—"1st, The driving of the spool case by placing the latter on a stationary spool case holder, within a cylindrical driver, having any convenient number of internal teeth, the driver being situated eccentrically with the holder, so that the internal teeth of the former may catch in the recesses in the edge of the spool case, and cause the same to revolve, at the same time leaving a space between the holder and the driver on the side opposite to that where the teeth act on the spool case for the play of the needle and its thread. 2d, The hooked lever, in combination with the cam on the driver."

8. For an *Improvement in Brick Press;* John Boynton, East Hartford, Conn.

Claim.—"The rotary matrices and the plate in which they are formed, hopper, filling plunger, compresses, bed or mould plate, and discharger."

9. For an *Improvement in Ice Breaking Boats;* Henry Brown and William Brown, Philadelphia, Penna.

Claim.—"The formation of a recess in the bows of a steamboat, said recess having inclined shelves and angular terminations, and angular rib, in combination with the guards, and the whole being arranged and constructed substantially in the manner set forth, for the purpose of breaking a channel through ice, and directing the broken pieces under the ice remaining on each side of the channel."

10. For *Improved Means for Attaching and Detaching to and from their Tackle;* John M. Brooke, U. S. Navy.

Claim.—"The application to boats and their hoisting and lowering apparatus, is a bolt with a hollow head opening on and forming part of a curved channel, or deflecting surface, having also a curved slot to correspond with the channel, so that a ball fitting conformably thereto, will, by the force of gravity, when permitted, follow this curve and be turned aside, and moreover will be prevented from re-attaching itself to the bolt if passing up and down before the aperture. Also, the arrangement of a cock or prop let into the side of the deflecting surface, so as to secure the ball in the head of the bolt when required, but offering no obstacle to its entrance."

11. For an *Improvement in Water Closets;* William S. Carr, City of New York.

Claim.—"The valve with its cylinder and openings constructed and acting in the seat. Also, the cup leather in the cylinder, fitted with the required amount of water leakage, when combined with said valve or cock and spring. Also, unlatching the pan from the lever to empty the contents thereof, and then retaining said pan in its depressed position while being washed out by providing the notch pin and hook, the whole constructed and acting in connexion with the gradual motion of the stern."

12. For an *Improved Envelope;* William H. Coates, Philadelphia, Penna.

Claim.—"The construction of envelopes with an extra turn down, said turn down being finished with adhesive substance."

13. For an *Improved Sash Supporter;* Charles H. Dana, West Lebanon, N. H.

Claim.—"The lever with roller on axle or pivot, arranged and operating in the inclined groove."

14. For an *Improved Printing Press;* William H. Danforth, Salem, Mass.

Claim.—"1st, The traveling bed plate and its attachments, in combination with the beds, worm shaft and crank, (or their mechanical equivalents,) and table. 2d, The improved manner that I have designed, forming the two setts of griping bars for insuring an equal gripe upon the sheets throughout their whole length, and in the manner of arranging the two sets of endless chains to which they are attached, so as to allow the two sets of griping bars to act together continuously upon the leading edge of the sheet from the time that they seize upon it until it is discharged printed from the machine, and also in the manner of insuring precision and exactness of action to the griping bars, at the time that they seize upon and relapse their hold upon the sheet, by the employment of the bar separators and brush. 3d, The movable or vibrating guide and gauge frame, constructed, arranged and operated, for the purpose of holding the ends of the curved griping bars together, while they are required to gripe the sheets, and for giving to the cross strings by means of the side lips or flanches, their required degree of tension to enable them to hold up the centre of sheets between the cross bars, while passing them across over the types, and also enable them to withdraw the prtnted sheet from off the face of the types, by not allowing the chains to be displaced from the lines

that they are required to travel in by this act, and for guiding the two sets of chains and their attachments across in a line above the face of the types and pile of discharged sheets. 4th, The employment of a series of pendants suspended from movable top pieces, so that they can be moved in or out to adapt them to the various widths of sheets required to be printed, and keep them always in lines that are parallel to each other, for the purpose of uniformly guiding the discharged sheets as they fall to the pile. 5th, The device employed for giving the necessary interval of rest to the feeding chains, griping bars, &c., at the time that the impressions are to be given, consisting of the feeding pulleys, feeding wheel, ratchet wheel, pall stud, adjustable grooved disk wheel, cam, disks, pawls, pins, and brake levers. 6th, Feeding the ink supply apron between the pressure roller and the periphery of the ink fountain roller, in a manner for the purpose of insuring a graduated and an equal deposit of ink upon all parts of its surface."

15. For an *Improvement in Carpet Fastenings;* S. R. C. Denison, Rochester, N. Y.

Claim.—"My method of fastening carpets, by means of the metallic cams attached to the base board, which cams not only hold the carpet firmly in its place, but afford facilities for its instantaneous removal in case of fire or other emergency."

16. For an *Improved Metal Pavement;* Solomon B. Ellithorp, City of New York.

Claim.—"A metal block for pavements, formed of a series of groined arches, alternating in position, and connected to ridge or string pieces, with interstices between the arches to be filled with cement, gravel, or sand."

17. For *Improvements in Mechanism for Compressed Air Railroad Signals;* John W. Fowble, Cincinnati, Ohio.

Claim.—"The arrangement of the valves and lever valve with the air chest, when acted upon by the compressed air, for the purpose of setting in motion the alarming apparatus for purposes mentioned. Also, the arrangement of the levers, rods, lever, catch plates, and springs, and these arranged with the shafts and levers, for the purpose of re-setting the alarming and signal apparatus as before described when operated on by the lever valve."

18. For an *Improvement in Bagasse Furnaces;* Samuel H. Gilman, New Orleans. Louisiana.

Claim.—"The combination of a dome-covered cylindrical chamber, having a circular base, with a draft door, located at an arch-covered second square chamber, a pit, a heat conduit or throat. Also, the location in a bagasse furnace of the draft door, or opening through which the air is admitted to support combustion, at or near the hearth level or fire beds, and directly opposite the opening through which the products of combustion leave the first chamber of the furnace, and in the vertical plane passing through the centre of the two chambers, and the centre of the opening where the two chambers unite, when the hearth of the second chamber is substantially on a level with the hearth which supports the bagasse to be burned."

19. For an *Improved Wrench;* Lorenzo D. Gilman, Troy, New York.

Claim.—"The use of the adjustable jaws, moving in the slot, and operated in connexion with the groove in the jaws, forming an adjustable socket."

20. For an *Improved Instrument for Breaking Ice;* Isaac H. Griffing, City of New York.

Claim.—"The loop rod, the sliding ball or weight, and the point, all in connexion, using for that purpose any metal of any size or shape, that may be necessary for the purpose of ornament, or for obtaining the object in view, viz: breaking ice."

21. For an *Improvement in Knitting Machines;* Augustus J. and Demus Goffe, Cohoes, New York.

Claim.—"The employment of a stationary circular converging series of hooked needles, arranged in a plane, and made to slide in respect to the revolving or traveling yarn carrier and presser, and also, in regard to the stationary ring of stops, in connexion with the inside web guide."

22. For an *Improvement in Straw Cutters;* J. H. Gooch, Oxford, N. C.

Claim—"Providing a support on the axle, and having the axle, stationary, and the knife revolve on the same."

23. For *Improved Blanks for Bank Notes, Bills, &c.;* Peter Hannay, Washington, D. C.

Claim.—"The combination of the arts of photography and printing or writing, or both."

24. For an *Improvement in Means for Guiding Line Ferry Boats or Flying Bridges;* Wm. A. Jordan, Thibodeaux, Louisiana.

Claim.—"The vibratory lever, constructed, and arranged, and operated with a cable."

25. For an *Improvement in Corn and Cob Mills;* Jacob O. Joyce, Cincinnati, Ohio; ante-dated, Feb. 5th, 1856.

Claim.—"The arrangement of the segments on the upper cone, and the segment on the lower cone, so that the former shall pass through between the latter, gradually contracting the spaces between their crushing surfaces."

26. For an *Improvement in Locks;* Joseph M. Lippincott, Pittsburgh, Penna.

Claim.—"The use of a stationary tumbler chamber, with movable wards and tumblers, in combination with the fence. Also, the use of an aperture in the tumblers, into which the grooves for the passage of the fence open, but distinct therefrom, for the purpose of allowing the tumblers to resume a position in which the grooves are out of range while the fence is yet engaged in the tumblers."

27. For an *Improved Pen-Holder;* T. Kenton Lyon, Richmond, Virginia.

Claim.—"The guard attached to or made part of the holder, forming a deep annular space around the pen or that part of the holder where the pen joins it."

28. For an *Improvement in Lightning Rods;* David Munson, Indianapolis, Ind.

Claim.—"Constructing a tubular lightning rod with spiral flanches, one of which is left open or divided its entire length, for the purpose of admitting the electric current to the inner surface of the rod, to diminish its intensity and mechanical effect."

29. For an *Improvement in Rotary Knitting Machines;* S. W. Park and Edgar S. Ells, Troy, New York.

Claim.—"Combining together two annular series of hooked needles with a sinker, two pressers and an ived guide. Also, the manner of arranging two annular sets of needles in relation to each other, that is, arranging them together, so that the hooked ends of the needles of one set, are parallel or nearly parallel with, alongside of and pointed in the opposite direction to those of the other series. Also, the improvement of arranging the sinker to increase the distance between the yarn and the old loops of the second set of needles just before the barbs of these needles are pressed. Also, the improvement of arranging the cam so as to spring out the ends of the second set of needles. Also, the improvement of holding the needles of an annular series in place on the grooved needle block, or its equivalent, by the ring."

30. For an *Improved Door Stay;* Anson H. Platt, Yellow Springs, Ohio.

Claim.—"The use of the bolt, the lever, and the dog."

31. For an *Improvement in Heating Feed-water Apparatus for Steam Boilers;* John R. Sees, City of New York.

Claim.—"The heating pipes and the branch pipes, and with the chamber containing the double acting check valve and the circulating pipe, all arranged below the water line of the boiler."

32. For an *Improved Combined Steam and Hot Air Cooking Stove;* John Shopland, Honesdale, Penna.

Claim.—"The arrangement of a boiler outside and independent of the oven, so as to have the hot air and steam at variable temperatures, and mix them at pleasure, or as the character of the cooking may require."

33. For an *Improved Mode of Coloring Photographic Pictures on Glass;* D. B. and H. B. Spooner, Springfield, Mass.

Claim.—"The application of gum arabic or other equivalent material."

34. For an *Improvement in Breech Loading Fire Arms;* Gilbert Smith, Buttermilk Falls, New York.

Claim.—"Producing a flexible lip from the solid metal of the rear of the chamber, to

operate as and for the purpose set forth, by forming a groove round the chamber at a short distance from the extreme rear thereof."

35. For an *Improvement in Hemp Brakes;* Meriwether Thompson, Jr., St. Josephs, Missouri.

Claim.—"The arrangement of the cone, pulleys or equivalent mechanism for varying the speed, and the arrangement of the slotted arm, shifting pitman, in such relation to each other, that by the described connexion between them, through the shifting lever and the cord, or their equivalents, and change of speed shall effect a corresponding change in the stroke of the brake."

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36 For an *Improved Corn Sheller;* Calvin Adams, Oak Hill, New York.

Claim.—"Alternating the annular rows of rotating teeth of the shelling cylinder, with stationary toothed rings, when the said shelling cylinder is combined with a rack, composed of a series of self-adjusting toothed segments."

37. For an *Improved Washing Machine;* Daniel N. Allard, Bokely, Ohio.

Claim.—"In combination with an endless apron for conveying the clothes to be washed, the series of rotating pounding balls."

38. For an *Improvement in Invalid Supporters;* James T. Alston, Raleigh, N. C.

Claim.—"Hinging the cushioned back thereof, to the central connecting cross-piece of its base frame, when the side pieces of said frame, in front of said cross-piece, are left open for the reception between them of an invalid to receive the benefit of the back and arms of said supporter. Also, connecting the arms to the base frame of the supporter, in such a manner that either of said arms can be readily detached from said frame and be confined therewith again, when the said base frame is left open in front, and is combined with the back of the supporter. Also, combining the recessed flaps with the arms of my improved invalid's supporter, when the said arms are arranged in conjunction with the base frame, and the back of the supporter."

39. For an *Improvement in the Production of Oil from Cannel Coal;* Luther and William Atwood, Waltham, Massachusetts.

Claim.—"An improved oil, obtained by the processes from natural bodies, which, alone or when mixed, afford paraffine indestructive distillation."

40. For an *Improvement in Preparing Oil from Bitumens;* Luther and William Atwood, Waltham, Massachusetts.

Claim.—"The manufacture and use of the oil from bitumens, which do not yield paraffine by distillation."

41. For an *Improvement in Mowing Machines;* Ephraim Ball, Canton, Ohio.

Claim.—"The lock fastening for such cutter bar, made by the removed and upset portions of the brace, and the extremity of the cutter bar."

42. For an *Improvement in Odometers;* Smith Beers, Naugatuck, Connecticut.

Claim.—"The flexible connecting shaft, composed essentially of a chain and spiral spring, or their equivalents, arranged and operating."

43. For an *Improvement in Steering Apparatus;* John W. Drummond, Norwalk, Connecticut.

Claim.—"Arranging a pinion having two leaves or wrists in such a manner, relatively with the sector or wheel acting on the rudder, that the said wrists or leaves can be turned into the plane of motion of said sector or wheel, to prevent motion to the steering wheel by any surge or wave against the rudder. Also, in combination with the aforesaid two-wristed or leaved pinion, the headed rod and spring, or their equivalents, to tend always to bring the said two wrists or leaves into the plane of motion of the sector or wheel."

44. For an *Improvement in Accordeons;* Anthony Faas, Philadelphia, Pennsylvania.

Claim.—"The sliding perforated board, when the said board is combined with the perforated board in such a manner as to produce the effects. Also, the double keys."

45. For an *Improvement in Dies for Screw Blanks;* Charles R. Gardner, Detroit, Michigan.

Claim.—"The elevation and the slope each."

46. For an *Improvement in Manufacture of Sheet Metal Ware;* Theo. Gomme and Charles E. A. Beaugrand, Paris, France.

Claim.—"The use of the rod, sliding within the stamping puncheon, for giving motion to the plate on the upper part of said puncheon, so as to hold the work in place, and subsequently to disengage it: the whole operating for preserving the thickness of the metal uniform when acted upon by the puncheon, between the grooved and beveled rings."

47. For an *Improved Fruit Box;* Jabez W. Hayes, Newark, New Jersey.

Claim.—"The combination of the two pieces of veneering, with the notches or slots, and the longitudinal openings interwoven at the centre, bent at right angles, and secured together by the cord in the slots."

48. For an *Improvement in Fire Arms;* Frederick W. Hoffman, City of New York.

Claim.—"So combining the cap with the cock, that the opening and closing of the end of the barrel shall be effected by the act of cocking the piece."

49. For an *Improvement in Filtering Sand for Cider;* Ira Holmes, Leicester, N. Y.

Claim.—"The discovery and process for making a beverage and syrup from the juice of apples."

50. For an *Improved Method of Raising, Lowering, and Operating Farm Gates;* Chester Hunter and N. Isham, Norwalk, Ohio.

Claim.—"The bars, spring, groove, and clasps."

51. For an *Improvement in Coal Hods;* Cyrus F. Kneeland, Buffalo, New York.

Claim.—"A coal hod, with a wood and metal bottom, made and secured in its place."

52. For an *Improvement in Vehicle for Paint Compounds;* Frederick Kulhmann, Lille, France.

Claim.—"The admixture of silicate of alkaline substance with a paint, varnish, ink, or dye, (instead of using it in layers or coatings, as heretofore done,) using for the protection of the several individual coloring matters, such agents as are known to scientific or practical chemists."

53. For an *Improvement in Felting Hat Bodies;* E. R. Barnes, Brookfield, and James B. Blakslee, Newton, Connecticut.

Claim.—"The peculiar arrangement of suspending and rendering elastic and adjustable, the endless rotating bed of felting machines, so that it may be elevated or depressed while in operation, and at the same time possesses an oscillating motion in order to adapt itself to the varying stages of the process of felting."

54. For an *Improved Nail Plate Feeding Apparatus;* Adolphus Heddaeus, Pittsburgh, Pennsylvania.

Claim.—"1st, Connecting the feeding apparatus with the nail machine, by ball wrists or universal joints, in some point or points, situated in a vertical line through the centre of the nail when cut, and in locating all the points of such connexion in this vertical line for the purpose of giving the feed apparatus a lateral motion in the arc of a circle, whose cutter is in that vertical line, whereby the feed apparatus may be accurately adjusted without stopping the operation either of the feeder or nail machine. 2d, The use of an elliptical spring or steel hoop, as the bearing for the front end of the feed screw, in combination with the sleeve, ball, cam, and spring, for the purpose of allowing the turning of the nail plate, and drawing it back while turning. 3d, The use of the large wheel, in combination with the pawl and pinion, for the purpose of communicating the requisite motion to the feed screw and nail plate, together with the cam wrench to lower the spring of the pawl, whereby the feed apparatus may be instantaneously stopped, without interfering with the action of the nail machine, or detaching the one from the other."

55. For *Improved Fire Arms;* Frederick D. Newbury, Assignor to Richard V. Dewitt, Albany, New York.

Claim.—"The releasing spring to throw the arm promptly down to permit a recharge of the piece. Also, the concave breech seat, or its substitute. Also, the method of arranging the tape priming by inserting the same through the stock, either with or without metal tubing. Also, the spring, when applied to the stock, to prevent the retraction of

the tape, and to cover the priming from the weather. Also, the feeding spring piece, in combination with the lever as its moving power."

56. For an *Improvement in Fire Arms;* Abner N. Newton, Richmond, Indiana.

Claim.—"Two or more expanding bands, in combination with the chamber and sliding breech pin, completely overlapping the joint between said breech pin and chamber."

57. For an *Improved Sash Fastener;* Wm. Patton, Towanda, Pennsylvania.

Claim.—"The supporting and self-locking sash fastener, composed essentially of the plate, bolt, and catch, when said bolt is arranged in an upright position, and hung forward of its fulcra, so that its whole weight shall tend to throw it into the catches."

58. For an *Improved Gold Washer and Amalgamator;* Warren S. Pierce, North Attleborough, Massachusetts.

Claim.—"Constructing the washer or separator, having the furnace placed within the case, which has oblique or taper sides, the ledges or plates placed on the top plate of the furnace, and the screen, and the sponge which is fitted between the screens placed in the case."

59. For *Improved Files;* George M. Ramsay, City of New York.

Claim.—"Constructing flat files in pairs, or with right and left cutting edges or corners. Also, in making the grooves to run, in combination with said files."

60. For an *Improvement in Artificial Stone;* St. Julien Ravenel, Charleston, S. C.

Claim.—"The substitute for stone, marble, or brick."

61. For an *Improved Mode of Attaching Ink Stands to Desks;* L. R. Satterlee, Rochester, New York.

Claim.—"Attaching ink stands to desks or tables, by means of the base plate, cap, and screws."

62. For *Improved Spring Pulleys for Window Sashes;* John Shopland, Honesdale, Pennsylvania.

Claim.—"In combination with the pulley and spring, the self-acting compensating brake for holding the pulley at any fixed point regardless of the increased power of the coiled spring, as it is wound up in drawing down or raising a sash, door, or other thing to which it may be attached."

63. For an *Improved Machine for Throwing Projectiles;* A. B. Smith and William Weaver, Clinton, Pennsylvania.

Claim.—"The conformation of the ring, which encloses the revolving disk with a movable muzzle. Also, the spiral tube, for gradually communicating the motion of the disk to the balls when its outer end is turned radially (or thereabout) outward, and is provided with a valve in said radial portion. Also, the mode of opening the valve, whereby the balls are invariably brought to the ring at a given point, and that point changeable at pleasure, irrespective of the position of the ring relative to the disk, or of the point to which it may chance to be directed. Also, the employment of the cam."

64. For an *Improvement in Manufacturing Chairs;* Edward Q. Smith, Cincinnati, O.

Claim.—"The arrangement of the sliding table, in combination with the cutter head and cutters, furnished with the adjusting piece for holding the pillar to its proper relative position to the cutter head, or equivalent means for making the top of the pillar the desired form and size to fit the dovetail in the chair back."

65. For an *Improvement in Treating India Rubber;* Wm. F. Shaw, Boston, Mass.

Claim.—"The treatment of sulphured rubber, or gutta percha, with unsulphured drying oils, or unsulphured rubber, or percha, with sulphured drying oils."

66. For an *Improved Method of Lettering and Ornamenting Glass;* Jerome B. Shaw, Pittsburgh, Pennsylvania.

Claim.—"The employment of patterns of metallic foil, and cementing the same to and removing them from the glass, whereby I am enabled to produce ornamental designs on glass at a greatly reduced cost."

67. For an *Improvement in Corn Harvesters;* Andrew Sprague, Coldwater, Michigan.

Claim.—"The guard, in combination with the knives."

68. For an *Improvement in the Manufacture of Hat Bodies;* Alva B. Taylor, Newark, New Jersey.

Claim.—"Regulating the distribution of the fur or other stock, upon the perforated cone, by varying the feed to the picking cylinder at different parts of its length."

69. For an *Improved Mode of Extracting Stumps;* Wm. O. Thompson, Orange, and Leonard Harrington, Worcester, Massachusetts.

Claim.—"The combination and arrangement of the lever and gallows frame, in connexion with the pulleys or power applied."

70. For an *Improvement in Planing Metal;* Chester Van Horn, Springfield, Mass.

Claim.—"Supporting the cross slide by means of the uprights, with the beam fitted between them at one side of the bed plate and framing, and having either one upright or two at the opposite side of the bed plate and framing."

71. For an *Improvement in Spinning Frames;* Thomas W. Taylor, Cannelton, Ind.

Claim.—"The construction, arrangement, and driving of the flyers of fly-frames, in combination with either a live or dead bobbin spindle, as the case may be."

72. For an *Improvement in Valve Gear for Steam Hammers;* Charles W. and John P. Willard, Dorchester, Massachusetts.

Claim.—"The combination of the bent rocker lever, the actuator, and the two adjustable cams, the whole being applied together, and to the valve rod and trip hammer."

73. For an *Improved Rock Drill;* George H. Wood, Green Bay, Wisconsin.

Claim.—"The combination of the hooked pitman, crank, and strap, as a mechanism for lifting the drill."

74. For an *Improvement in Blast Furnace;* Wm. Wright and George Brown, Newcastle, England.

Claim.—"The general arrangement and construction of cupolas and smelting furnaces for the self-heating of the air blast, by the arrangement of the chambers and air passages."

75. For an *Improvement in Processes of Separating Silver from Tin Ore;* Wilhelm Beirvogel, Trescow, Pennsylvania.

Claim.—"The application of water or a solution of sulphate of copper, slightly impregnated with sulphuric acid, instead of lead, quicksilver, or salt, hitherto used for this purpose, to the process of separating silver from copper, and other ores, rendering thereby this separation easier, shorter, less expensive, and not noxious to the health of the operator."

76. For an *Improved Machine for Wringing Clothes;* Robert P. Bradley, Cuyahoga Falls, Ohio, Assignor to Joel Wisner, East Aurora, New York.

Claim.—"The construction and arrangement of the springs, so as to compensate for shortening in the act of wringing, at the same time form posts at the sides for bearings."

77. For an *Improved Chimney Cowl;* George W. Thatcher, Philadelphia, Penna.

Claim.—"The introduction of one or more central tubes, with their caps or frustrums enclosed within an outer tube with its cap or frustrum, and extending downwards within the outer tube, so as to increase the upward draft and afford protection from winds and storms."

78. For an *Improved Ore Washer;* Hezekiah Bradford, Assignor to Horatio Bogert, City of New York.

Claim.—"The employment of a hollow perforated cylinder, rotating on a horizontal, or nearly horizontal axis, provided with numerous pins or teeth on the periphery pointing towards the axis, combined with a feeding aperture and hopper at one end, and lifting scoops and delivery aperture at the other end; and with a water trough or vessel, within which the lower part of the said cylinder revolves, the said trough or vessel being provided with a delivery aperture controlled by a valve."

79. For an *Improvement in Refrigerators;* Thaddeus Fairbanks, Assignor to John C. Schooley, St. Johnsbury, Vermont.

Claim.—"Combining an ice receptacle with the interior of a refrigerator, as that a continuous circulation of air shall be kept up through the ice in said receptacle, and through the interior of the refrigerator, and so that the circulating air shall deposit its moisture on the ice every time it passes through it, and be dried and cooled, passed through the interior of the refrigerator."

80. For an *Improvement in Brick Machines;* Isaac Harman, Assignor to self, and William Bickel, Tamaqua, Pennsylvania.

Claim.—"The moulds, composed of the two halves having any convenient number of angular projections and recesses, the points of the angular projections of one-half coinciding with those of the other half, the said moulds being caused to expand and contract."

81. For an *Improvement in Vapor Burning Lamps;* Samuel Whitmarsh, Northampton, Massachusetts, Assignor to Wm. J. Demerest, Orange, New Jersey.

Claim.—"The method of heating the air, supplied through the air holes in the outer cylinder, in the space between the cylinders."

AUGUST 19.

82. For an *Improved Mould for Pressing Glass Fountain Lamps;* Henry W. Adams, City of New York.

Claim.—"The mould."

83. For an *Improvement in Lime Kilns;* Levi Avorill, Elmira, New York.

Claim.—"The construction and arrangement of the kiln with small separate branches, situated outside or around a single furnace, from which the heat is conducted through conveying passages to several points of their peripheries."

84. For an *Improvement in Furniture Polish;* John L. Brabyn, City of New York.

Claim.—"The combination of muriatic and acetic acid, with the usual ingredients of furniture polish, in the proportions and manner specified, for the purpose of producing a polish capable of resisting the action of hot or cold water."

85. For an *Improved Blastic Compound;* Lewis Buchholtz, Richmond, Virginia.

Claim.—"The composition and application of the above mentioned ingredients, whether in the ratio described, or any other substantially the same."

86. For an *Improvement in Coupling Pipes;* George Fetter, Philadelphia, Penna., and John S. McClintock, Libertyville, Illinois.

Claim.—"A new and improved mode of attaching connexions to lead pipes, the tapering screw terminating in a smooth and rounded end on the connexions for the purpose of guiding the said screw, and preventing the lead from burring up inside the pipe, in combination with a tapering ferrule on the end of the lead pipe, said ferrule having any convenient number of projections for preventing the pipe from turning within the ferrule while the end of the said connexion is being secured into the pipe."

87. For an *Improved Farm Fence for Rolling Ground;* Ephraim D. Foss, Mainville, Ohio.

Claim.—"The vertical shifting base post, in combination with the arrangement and use of the tenons."

88. For an *Improvement in Knife Cleaners;* William W. Hopkins, Chesterfield Factory, Massachusetts.

Claim.—"The reciprocating scourers and elastic bolster."

89. For an *Improvement in Felting Compounds;* Lansing E. Hopkins, Brooklyn, New York.

Claim.—"Keeping the articles to be felted constantly saturated with, or immersed in a solution of saponaceous matter during the operation of felting, and near the close of the operation, adding to said solution a small quantity or ammoniacal matter."

90. For an *Improvement in Paddle Wheels;* Abraham Houseworth, City of N. York.

Claim.—"The floats or buckets applied or attached to the wheel as shown, and expanded or spread, and contracted or closed by the cams."

91. For an *Improvement in Machines for Adding Numbers;* Isaac G. Hubbs, City of New York.

Claim.—"The disk with its continuous spiral tooth, the racked index and the indicator."

92. For an *Improved Machine for Sweeping Gutters;* Wm. H. King, Assignor to self and Isaac Hyneman, Philadelphia, Pennsylvania.

Claim.—"The combination of the skewed revolving brush and guiding board, for the

purpose of making a side or gutter sweeping machine, that will leave the sweeping in the winrows."

93. For an *Improvement in Thorough Braces for Carriages;* Frederick A. Jewett, Abington, Massachusetts.

Claim.—"Combining with a thorough brace a right and left threaded screw, working in nuts, whereby the thorough brace can be tightened, and the slack taken up at the same time."

94. For an *Improvement in Cupping Instruments;* Sherman McLean, Reynalis Basin, New York.

Claim.—"Constructing the cup with one or more smaller cups fitted and secured within it, and provided with perforated sides."

95. For an *Improvement in Harvesting Machines;* Larkin L. Moore, Petersburg, Va.

Claim.—"Adjusting the frame on its supporting wheels for cutting higher or lower, by uniting the frame and tongue by means of the pivoted hounds, screw-winch, and pin passing through a slot in the rear of the tongue into the standard."

96. For an *Improvement in Machines for Pressing Bonnets and Bonnet Frames;* Wm. Osborn, Louisville, Kentucky.

Claim.—"Forming the flaring face piece and side crown of a bonnet or bonnet frame in one piece and at one operation, and irrespective of the particular form of the bonnet or frame."

97. For an *Improved Machine for Forging Horse Shoe Nails;* Charles Parkhurst and Charles Weed, Boston, Mass.

Claim.—"1st, Making the nail guide movable up and down with respect to the anvil, and its top and lateral hammers, when said anvil is made stationary as specified, said improvement being advantageous in several respects. 2d, The combination of mechanism for operating said nail guide, or removing it from the anvil to the cutters, and retaining it between the cutters during the descent of the vertical slider far enough to separate the nail from the rod, said combination consisting of the lever latches, the eccentric, the rocker lever, and the springs applied to the guide, and the vertical slider."

98. For an *Improved Tenoning Machine;* John Potter, Ellicottsville, New York.

Claim.—"1st, The combination of the revolving knife, cutter heads, and rotating saws, when these devices are arranged in relation to each other, and for operation together, causing the knives of the cutter heads to relieve the saws from binding, and ensuring many other advantages in the cutting of the tenon as specified. 2d, The alternate arrangement on the cutter heads, when operating in relation to and connexion with the saws of the square and level nosed knives or cutters for action with each other, and the saws in the formation of the shoulder."

99. For an *Improved Bristle Separator;* Adonijah Randel, City of New York.

Claim.—"The vibrating board and discharging rollers."

100. For an *Improved Hand Stamp;* Edwin A. Russell, Hookset, N. H.

Claim.—"Combining with the movable lever or stamp carrier and beds, whereby during, and by the lateral movements of the said lever or stamp carrier from one bed to the other, the stamp shall not only be struck or forced downwards, but raised off the same, such mechanism be a trip hammer with its operating spring, a cam, and a spring, constructed and made to act with respect to the stamp and its carrier."

101. For an *Improvement in Cart Saddles;* Henry A. Rains, Nashville, Tennessee.

Claim.—"Uniting the tree bars and pads of a saddle, by providing said bars with grooves around their edges, or with grooved rims or the linings of the pads with looped, corded or perforated borders, which are firmly but removably secured in the grooved edges of the tree bars, by wires, cords, or bands, passing through or around said loops or borders, and held by right hand and left hand screws, or equivalent fastenings."

102. For an *Improvement in Valve Motions for Steam Engines;* Edward S. Renwick, City of New York.

Claim.—"1st, The combination of the parts of a valve motion, so that the steam valves shall be opened by mechanism at intervals coincident, or thereabouts, with the

opening of the exhaust valves, and that the steam valves shall be closed by mechanism, that is, independent of the exhaust valves, but which governs and controls the toes, by which the steam valves do not change the angular position in which these toes have been placed to open the valves. 2d, The combination of the steam toes, rock shaft, arms and link, with the exhaust rock shaft for opening the steam valves. 3d, The combination of a cam, and spring cam box, with mechanism for imparting the movement of the cam box to the valves. 4th, The combination of the yokes and shaft, with appropriate operating mechanism depending upon the movement of the crank shaft of the engine, for holding the steam toes in the proper position to open the valves and for lowering the same bodily to close the steam valves. 5th, Closing steam valves that have been opened by moving the steam toes, or their equivalents, bodily, without changing their angular position the distance required to shut the valves."

103. For an *Improvement in Projectiles;* Nathan Scholfield, Norwich, Conn.

Claim.—"1st, The application of wings, either with slight springs to force them from close contact with their seats when left free, so as to allow the air to act thereon to perfect their expansion, or by having a free passage for air beneath the wings, and giving them a slight inclination diagonally on the cylindric surface and without springs. 2d, The construction of the guiding wings for a projectile to be fired from a gun of thin sheets of metal, having one of their edges folded around a piece of wire, or its equivalent, to form journals on which the wing may turn as joints. 3d, Applying these wings, either plane or curved, on the cylindric surface of a projectile, and either parallel to its axis, or diagonally in such form and position that the said wings may be closed down on the cylindric surface, or on grooves thereon fitted to receive them, and by the action mainly on the air on the wings as the projectile is discharged, they shall be opened and expanded, as above described. 4th, The construction and application of these wings slightly curved, composed of metal possessing sufficient elasticity to resume their curved form after being changed therefrom, so that if while its rear end rests on its seat, the forward end of the wing is elevated therefrom when free, then, if this end is also pressed down to its seat, it shall be raised again by its elasticity when left free from pressure, so that the action of the air on the exposed curve of the wings will force them open to their greatest capacity after being discharged from a gun."

104. For *Improved Bedsteads;* John H. Belter, City of New York.

Claim.—"1st, A bedstead constructed of thin parts, supported independently without posts or joints, when the parts are composed of veneers. 2d, The wedge-shaped projections on the inside face of each part of the shallow notches on the edge of the internal frame."

105. For an *Improvement in Concentration of Milk;* Gail Borden, Jr., Brooklyn, New York.

Claim.—"Producing concentrated sweet milk by evaporation in vacuo, the same having no sugar or other foreign matter mixed with it."

106. For an *Improvement in Wheels for Carriages;* Thomas Brownfield, Georges Township, Penna.

Claim.—"The rim of the hub which is made in sections, which being constructed in this manner will press on all the spokes, and hold them all firm in the hub, and the iron plate which covers these sections, which will bend and let the sections fit the spokes with the pressure of the screws, and hold the sections in their places, and the nuts on the spokes which hold the felloes and tire to their proper places."

107. For an *Improved Door Spring;* John Broughton, Chicago, Illinois.

Claim.—"The employment of an additional hinge unfolding and folding the reverse of the hinges, and having formed on each of its leaves, a quadrantal or other suitable projection, in combination with the flat or other suitable springs."

108. For *Improved Carpenters' Gauges;* Joel Bryant, Brooklyn, New York.

Claim.—"The invention, construction, and exclusive right and use of point holders, or holders for the points, markers, and cutters of gauges, irrespective of the kind or form of gauges, or instruments equivalent thereto."

109. For an *Improved Sash Supporter;* Charles S. Bruff, Baltimore, Md.

Claim.—"The application of the rack, corrugated in the particular form described to one edge of a sash, and the metal spring catching into said corrugations secured in the

jambs, or on the stop bead, for the purpose of holding up window sashes at any desired elevation."

110. For an *Improvement in Clamping and Upsetting Tire;* Oscar L. Coubes, Tecousha Township, and Allan L. Denning, Homer Township, Mich.

Claim.—"The combination of the lever with the auxiliary clamping levers, the carrying studs, the connecting bars, the saddle piece, and the slotted clamping bars, for the purpose of clamping and then upsetting tire by single continuous motion of the slotted lever."

111. For an *Improved Method of Regulating Velocity of Feed for Sawing Mills;* R. Eickemeyer, Yonkers, New York.

Claim.—"Driving or operating the log carriage by means of two shafts, placed more or less out of line with each other, and connected by a pin or grooved plate, or draw link, or any other equivalent device, for the purpose of giving a variable movement to the carriage, thereby feeding the log to the saw."

112. For an *Improved Window Sash;* Francis Sessions, Worcester, Mass.

Claim.—"The new or improved combination or manufacture of window sash, as made not only of rebated and tenoned side and cross bars, but of separate rebated corner pieces, or combinations cast in manner as specified on the tenoned ends of said bars, and not only constituting rebated annular continuations thereto, so as with said bars to complete the sash frame, but serving to connect the bars together."

113. For an *Improved Arrangement of Steam Cylinder within the Boiler;* John S. Shapter, City of New York.

Claim.—"Enclosing a steam cylinder in a steam chamber, separated from the body of the steam boiler, where the supply of steam can be shut off from the chamber by a valve for that purpose, and where the cylinder and its attachments can be got at through a man hole, when the supply of steam to the chamber is so shut off."

114. For an *Improved Washing Machine;* John S. Shepler, Beaver, Penna.

Claim.—"The forming of ribs in sections parallel to the rubbers, and gradually forming a double inclined plane out of any odd number of ribs, thus causing a wedge-shape opening between the ribs of equal opening when vertical to each other, to admit the clothes as the machine rotates back and forth, without the abrupt contact caused where the ribs are of equal height."

115. For an *Improved Head Rest to be used in Railroad Cars;* William B. Slaughter, Chicago, Illinois.

Claim.—"The yoke, together with its mode of attachment to the person, and the combination of the hand rest with the yoke, so that it can be attached to the person and made to serve the purpose of a head rest without any other attachment."

116. For an *Improvement in Harvesters;* William Tinker, Kellogsville, Ohio.

Claim.—"Forming the cutting teeth with narrow back projections, having cutting edges parallel to each other along the sides of each projection so as to cut at right angles to the face of the finger bar, when said projections are arranged for operation over the fingers between the finger bar and sickle, in combination with the wiper wheel, driving appliance for giving an abrupt action to said cutters, for the better clearance from grain or grass of the space which separates the finger bar and sickle."

117. For an *Improved Vice;* R. W. Thickens, Brasher Iron Works, New York.

Claim.—"The combination of the levers or bars, and slotted arm, arranged and applied to the jaws."

118. For an *Improved Self-Clearing Chimney Cowl;* Charles H. Watkins, City of New York.

Claim.—"One or more legs, having the circle of the revolving top, and connected with a common spindle."

119. For an *Improvement in Water Proofing Textile Fabrics;* Benjamin Weigert, City of New York.

Claim.—"The treatment of textile fabrics with a solution of acetate of alumina and glue."

120. For an *Improved Grapple for Raising Sunken Bodies;* Greenleaf A. Wilburn, Skowhegan, Maine.

Claim.—"The improved construction of the grapple to be operated with a buoy and staple."

121. For an *Improved Apparatus for Boring Artesian Wells;* Clarendon Williams, Franklin, Missouri.

Claim.—"The boring of earth and stone, and sinking of tubing at one operation, forming artesian wells by the mechanism employed, consisting of screw and nut."

122. For an *Improved Machine for Swaging Iron;* John T. Willmarth, Worcester, Massachusetts.

Claim.—"Mounting the hammers on opposite sides of a rocking frame, operated by eccentrics, or their equivalents, in combination with the anvils placed on opposite sides of the axis of vibration of the said rocking frames."

123. For an *Improvement in Locks;* Hjalmar Wynblad, City of New York.

Claim.—"The arrangement of a series of eccentric disks, separated by stationary ward plates, with each of said disks having an orifice at the centre of its motion, fitted to the shape of the bits of the key, and moving upon and guided by a segmental standard, and moved at the same time and to the same distance within a frame, and attached to and working the bolt of a lock."

124. For an *Improvement in Frames for Bleaching Ivory;* A. C. Breckenridge, Assignor to Julius Pratt & Co., Meriden, Conn.

Claim.—"Providing the bleaching frame with grooved strips of glass, to receive the ends or sides of the pieces of ivory, in such a manner as to retain the said pieces in the frame while it is turned over, and to leave every portion of the upper surface of the ivory exposed to the sun's rays, whichever side of the frame is upward."

125. For an *Improvement in Machines for Drilling and Dressing Stone;* William M. Barton, Assignor to self and Robert M. Barton, Russellville, Tennessee.

Claim.—"The arrangement of the drill on one side of the slab or stock, and the crank and connecting rod on the other, with the spring and vibrating arm, to connect the said drill and connecting rod."

126. For a *Musquito Canopy;* Levi J. Henry, Assignor to Benjamin J. Hart, City of New York.

Claim.—"1st, The construction of the clamp with the rod and screw studs, by which the canopy frame may always be made to stand vertically whether the clamp itself stand vertically or horizontally. 2d, The cap fitted to receive the bars for sustaining the canopy or covering, when combined with the sliding tubes for regulating the height of said canopy, and also receiving the bars when transported."

127. For an *Improved Wheelwrights' Machine;* A. D. Stowell, Assignor to John A. Place, Fulton, New York.

Claim.—"The combination of the spoke set with the carriage carrying the hollow auger, when the whole is attached to the hub while resting over the pit."

128. For an *Improvement in the Process of Preparing Linseed, &c., for Pressing, in Extracting Oils;* Charles Moore, Trenton, New Jersey.

Claim,—"Forming it or them into cakes, by moulding and partially pressing or packing it or them."

129. For an *Improvement in Rock Drills;* Wm. M. Barton, Assignor to self and Robt. M. Barton, Russellville, Tennessee.

Claim.—"The combination of the segmentally toothed wheel gearing into the ratchet wheel, with the spring and its drum."

130. For an *Improvement in Magneto-Electric Machines;* Edward Shepard, City of New York.

Claim.—"The springs, the flattener plates, the connecting rods, and the conducting bands or rings, when these are combined with helices in sets of four; said helices being united amongst themselves and by their terminal wires, with the rings or their mechanical equivalents, so as to collect and aggregate in one current the several currents generated in the said helices when revolved between the magnetic poles."

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131. For an *Improved Method of Applying one Stream of Water to assist in Raising another;* Charles J. P. Ariail, Roxbury, Connecticut.

Claim.—"The arrangement for raising water of two concentric annular channels, to which are fitted self-acting rotating valves, attaching to one channel a siphon, through the suction of which and pressure of water following, the rotating valves are operated."

132. For an *Improvement in Apparatus for Evaporating Salt;* William T. Clough, Newark, New Jersey.

Claim.—"The apron, chamber, and escape flues, arranged and combined with the pan."

133. For an *Improved Wind-Mill;* William C. Chambers and Thomas S. Hargraves, Brooklyn, New York.

Claim.—"1st, Attaching the plate which supports the wheel to the rudder plate, in such a manner as to allow it a vibrating rotary motion, whereby the mill is rendered self-regulating. 2d, The combination and arrangement of the segment gear, pinion, drum, and weights (or any equivalent mechanism), for holding and retaining the wind wheel always in a proper position."

134. For an *Improved Instrument for Laying Out Rafters;* Legrand Crofoot, Syracuse, New York.

Claim.—"The combination of the adjustable expanding measure, with the adjustable levels. Also, in combination with the above, the fixed square plates sliding on the levels."

135. For an *Improvement in Hay Rakes;* Charles P. Carpenter, St. Johnsbury, Vt.

Claim.—"The slotted bed plank, the movable head, the guide rods, the catch, and the connecting of the tugs to the brackets, by the links, or their equivalent device or devices."

136. For an *Improved Instrument for Measuring Distances from a Single Station;* Enoch A. Crandall, Friendship, New York.

Claim.—"The combination of the stationary telescope, the movable telescope, with its index bar and index, and the multiplying levers, with their indexes and springs, and by their respective scales."

137. For *Apple Parers;* Charles P. Carter, Ware, Massachusetts.

Claim.—"The disk, with its cover, and slicking knife, operating, viz: the purpose of the said disk being to regulate the motion of the apple by pressure of the hand, without the necessity of any other screw."

138. For an *Improvement in Condensers for Steam Engines;* John T. Denniston, Lyons, New York

Claim.—"1st, Forming a partial vacuum before the commencement of the eduction of the steam from the engine to the condenser, by first filling the condenser with water, and then partially withdrawing the water to form steam space. 2d, Suspending the water in the condenser in a number of cups or cells, with perforated bottoms and passages between them, thus causing the steam to circulate among, and over, and under the water in the cups, and through the shower of water falling through the condenser."

139. For an *Improved Self-adjusting Fog Bell;* Henry L. De Zeng, Geneva, N. Y.

Claim.—"1st, Attaching a float to a lever or arm, that is connected at or near the other end, to a fixed vertical shaft or axis, in such a manner that said float shall be allowed to swing around said vertical shaft or axis, and accommodate itself to the direction in which the swell or current or both are moving, so that said float is not subjected to any sideways concussion or strain from either the tide or swell, but is free to oscillate or vibrate with the swell, and communicate motion to any suitable bell or other alarm. 2d, Attaching the ends of a chain, or its equivalent, on opposite sides of a lever that receives a vibrating or oscillating motion from a swell, when said chain is passed over a cam-wheel, or other similar article, to communicate the motion imparted to the lever and chain, to the hammer of a bell or other signal of alarm. 3d, The arrangement of the cam and catch, relatively with the heel of the hammer, and with the chain, whereby the vibrating motion of the chain works the said hammers."

140. For an *Improved Cultivator;* Henry D. Gause, Freehold, New Jersey.

Claim.—"So constructing and arranging my cultivator, by means of the clevies, the beams, and brace, that in combination with the seat, the ploughs may be guided by the feet of the driver."

141. For an *Improvement in Manufacturing Seamless Hosiery;* Wm. Goddard, City of New York.

Claim.—"The process or method of manufacturing seamless hosiery of the form required for what is known as seamless tubular knitted fabrics, such as are knitted on machines, that knit the tubes of a uniform diameter, and adding thereto the ribbed top, the heel, and the toe, by hand knitting, or any equivalent therefor."

142. For an *Improvement in Seed Planters;* J. Herva Jones, Rockton, Illinois.

Claim.—"The use of a hinge or joint, or its equivalent, for connecting two single hand planters at their tops, for the purpose of allowing them, like a pair of compasses, to expand and contract in their operation."

143. For an *Improved Ball Caster for Trunks and Furniture;* Judson Knight, Newark, New Jersey.

Claim.—"The combination of the points, and the ball working in an open socket."

144. For an *Improved Bedstead;* Elias Howe, Jr., Brooklyn, New York.

Claim.—"A spring-bed constructed of a series of springs which over-lie each other, are combined together and arranged in an inclined position upon a bed bottom."

145. For an *Improvement in Air-Heating Furnaces;* John Liddle, City of N. York.

Claim.—"1st, The construction of the main body of the furnace, forming by plates attached to the internal surface, a series of tubes around its circumference, so as to form the smoke flues without any vertical joints between the interior and exterior, and without the employment of cores in casting. 2d, Also, making the lower section of the radiator, with the sides forming an acute angle, and in combination with the legs."

146. For an *Automatic Attachment to Gas Burners;* A. R. Marshall, Stratford, Conn.

Claim.—"1st, The combination with the thermostat and the valve, of the catch on the bar, and the system of levers for the locking and unlocking of the valve. 2d, Combining with the locking catch, or its equivalent, which is acted upon by the thermostat, another catch so arranged as to lock the valve open, until the catch is set in operation by the action of the thermostat, and then to be moved out of the way by the catch."

147. For *Curtain Fixtures;* Purches Miles, Hartford, Connecticut.

Claim.—"The levers, actuated by the coiled springs."

148. For an *Improvement in Hand Corn Planters;* Cornelius Martratt, Albany, N. Y.

Claim.—"The combination of the staff collar and spade, with reservoir."

149. For an *Improvement in Water Gauges for Steam Boilers;* Lucius Paige, Cavendish, Vermont.

Claim.—"Applying the said chamber, or arranging it with respect to the gauge, so that it shall partially surround the same, and form a niche or recess to receive such gauge, and radiate heat upon it towards its axis; the said recess being provided or not as the case may require, with the curved cover or slider made to operate therewith. Also, constructing the gauge in tubular sections of glass, or other suitable transparent material, in combination with providing the same with a clamp frame or apparatus, and connexions, rings, and caps."

150. For an *Improvement in Brick Machines;* Henry B. Ramsay, Indianapolis, Ind.

Claim.—"1st, The wheel, cranks, and catches, in combination with the springs, for the purpose of regulating the stroke of the knives for cutting the clay at the top of the moulds. 2d, The sliding mould table, for the purpose of raising the moulds to the grate under the clay box."

151. For an *Improved Amalgamator;* Alva M. Stetson, San Francisco, California.

Claim.—"The employment of the boxes placed in vertical succession, when said boxes are fitted with tubes or pipes for containing the quicksilver, and for distributing the water."

152. For an *Improvement in Making Lead Pipe;* John Robertson, Brooklyn, N. Y.

Claim.—"The construction and arrangement of the core, with the guide, in combination with the piston."

153. For *Improved Bedsteads;* Jacob J. Smith and Jonathan H. Pugh, Philadelphia, Pennsylvania.

Claim.—"Supporting the four main posts of a bedstead by screwing, or otherwise inserting them so that they shall stand securely without connexion with any rails upon the base, which rests immediately upon the floor; the said base frame being held together at its corners by means of the tenons on the said posts. Also, adjusting the said platform, or its equivalents, to any required inclination, by means of the right and left screw shaft, blocks, inclined planes, disk and plates, or their equivalents."

154. For an *Improved Fountain Pen;* Nelson B. Slayton, Madison, Indiana.

Claim.—"The fountain pencil, consisting of a tube tapering to a point, and slit from the said point some distance up two or more sides, said tube being connected with an ink reservoir, which is closed except at its connexion with said tubes, and from which the ink is caused to flow through the said tube and down the slits thereof, and issue from the point thereof, when the said point is moved in contact with a surface of suitable character to receive an inscription in ink. Also, regulating the degree of fineness of the writing or marks produced, by means of a screw thread and cone on the exterior of the tube, and a nut, carrying a conical cup fitted to the said screw thread and cone, and acting in opposition to the elasticity of the nibs of the tube."

155. For an *Improvement in Machinery for Filling Seine Needles;* Simon F. Stanton, Manchester, New Hampshire.

Claim.—"Giving the needles a vibrating motion, in combination with the arm which delivers the twine vibrated perpendicularly, and traversed horizontally, so as to deliver the twine across the score and around the tongue of the needle."

156. For an *Improvement in Bilge and Leakage Water Indicators for Ships and other Vessels;* Reuben Shaler, Madison, Connecticut.

Claim.—"The sectional diaphragm spring, as arranged in relation to the chamber and the standard."

157. For an *Improvement in Apple Parers;* Marvin Smith, New Haven, Conn.

Claim.—"1st, The construction of a machine for paring and slicing apples, in such a manner that a vibratory or oscillating motion may be given to the fork carrying the apple simultaneously with the axiel or rotating motion of the same, whereby I am enabled to use a paring knife that shall be automatic or self-acting in its operation, yet equally adapted to paring apples large or small. 2d, The knife and handle, hinged and operating in such a manner that the adjustment of the cutting edge of the knife to the entire surface of the apple, shall be coincident with the vibratory or oscillating motion of the fork carrying the apple. 3d, The pawl, or its equivalent, hinged at such a point with respect to the oscillating centre of the fork, that, as the said fork is moved in the direction of the hinge of said pawl, the point of contact between the fork and the pawls, shall recede from the oscillating centre of said fork."

158. For an *Improvement in Dynamometers;* George and John W. Gibbs, Canton, Ohio.

Claim.—"The register or pointer, which shows the average or mean draft in combination with the slot and pin, or its equivalent, which overcomes the vibrating motion of the pointer shown on the dial."

159. For an *Improvement in Cupping;* Loyall Tillotson, Thompson, Ohio.

Claim.—"The spiral wire, disk, and loop, combined and attached to a cupping instrument, for the purpose of employing electricity in conjunction with cupping as an adjuvant for diseased parts of the human body."

160. For an *Improvement in Machinery for Felting Hat Bodies;* Joseph Thomas, Brooklyn, New York.

Claim.—"The employment of a discharging slotted wheel, for feeding the goods into and through the machine."

161. For an *Improvement in Potato Diggers;* Silas Woolson, Woodna, N. Y.

Claim.—"The employment of an open concave digger, arranged and combined with a movable standard."

162. For an *Improved Implement for Milking Cows;* William H. Whitman, Bailey Hollow, Pennsylvania.

Claim.—"Placing the fingers within a case, and at the sides of holes in the case, the fingers being vibrated by means of the eccentric rollers and elastic bars."

163. For a *Grain Cleaner and Separator;* Richard Ward, Edinburgh, Indiana.

Claim.—"The combination and arrangement of the curved board, with the slide, the chaff conductor and the slide."

164. For an *Improved Method of Operating Farm Gates;* Caleb Winegar, Union Springs, New York.

Claim.—"Opening and closing gates by the means of the ratchet drum, the weight, or an eqaivalent spring to draw back the said ratchet drum through an intervention of the chains and rods. Also, my arrangement of rod and chain, connected with the spring catch for the purpose of attaching the latch."

165. For an *Improved Brace;* Daniel M. Baird, Warrensville, Assignor to Nathaniel Potter, Erie County, New York.

Claim.—"1st, Inserting the mandrel in the chamber, in the shank of the brace; this I claim in combination with the washer, set screw, and thumb piece. 2d, The manner of attaching the head of the brace to the spindle, by means of the thumb nut, and collar; this I claim in combination with the chamber that receives the collar and screw of the thumb nut."

166. For an *Improved Device for Preventing Liquids from Boiling Over;* John Liblong, Assignor to Edward Brown and James R. Case, Waterbury, Connecticut.

Claim.—"The cap, placed within the vessel, constructed as set forth."

167. For a *Machine for Sizing Comb Blanks;* Wm. Fosket and Benjamin S. Steadman, Assignors to Julius Pratt & Co., Meriden, Connecticut.

Claim.—"The gradually receding edge, arranged within or around, and inclining towards a rebate, so as to form a tapering opening between them, with a resting place at the narrow end of the opening, when combined with a set of arms, rotating or otherwise moving over the opening, and with boxes, compartments, or other receptacles below."

168. For an *Improvement in Sewing Machines;* A. F. Johnson, Assignor to self and F. A. Houghton, Boston, Massachusetts.

Claim.—"1st, The combination of a swinging ellipse as a shuttle thrower hung on a pivot, with a cam on the driving or other rotating shaft, so operating with said swinging ellipse, as that when the cam is bearing upon it near its pivot, it shall move the shuttle faster or through a larger space in the same time, than when it is bearing upon the other parts. 2d, The combination of the rocker-shaft and its arm, and connecting rod, with the grooved cam, operating together for giving the required motions to the feeding plate. 3d, The means employed for varying the length of the feed motion, and consequently the length of the stitch, at pleasure, the same consisting of a screw-shaft working in the hollow vertical shaft that moves the rocker-shaft, and raising or lowering a loose collar to which the connecting rod is attached."

169. For an *Improvement in Lamps;* Peter C. Guion and Paul K. Wombaugh, Cincinnati, Ohio.

Claim.—"The elastic bulb or reservoir surrounding and communicating at bottom with a hollow stem which supports and opens into the bowl, in the described combination with the air duct, having an inwardly opening valve, affording the described means of communication from the external atmosphere, to the upper part of the bulb, or equivalent devices."

ADDITIONAL IMPROVEMENT.

1. For an *Improved Apparatus for Raising and Lowering Carriage Tops;* Anson Quigley, Sheldrake, New York; patented April 22, 1856; additional, dated August 26, 1856.

Claim.—"The box, pawl or catch, in combination."

RE-ISSUES FOR AUGUST, 1856.

1. For an *Improvement in Photographic Pictures on Glass;* James A. Cutting, Boston, Mass.; patented July 11, 1854; re-issued August 12, 1856.

Claim.—"The combination of balsam, or its equivalent, with positive photographic pictures on glass, and with the additional glass, by which they with the balsam are hermetically sealed."

2. For an *Improvement in Apple Parers;* Charles P. Carter, Ware, Mass.; patented October 16, 1849; re-issued August 12, 1856.

Claim.—"1st, The combination of the spiral groove, the rack bar and sector, or their equivalents, for the purpose of moving the knife automatically. 2d, The combination of the spiral groove, the lever and the sliding bar, or their equivalents, for the purpose of throwing the apple from the prongs, after the paring is completed. 3d, Giving to the knife a slight play around its axis, independent of the mechanism which actuates it."

3. For an *Improved Machine for Making Wrought Iron Railroad Chairs;* Wm. Van Anden, Poughkeepsie, New York, Assignor (through others) to Alexr. Frear and Jacob Rowe, City of New York; patented April 13, 1850; re-issued August 12, 1856.

Claim.—"1st, The combination of two or more properly shaped dies, between which a chair blank is clamped, prior to the cutting of that portion of it which constitutes the lips thereof. 2d, The automatic shears, in combination with properly shaped dies, for clamping a chair blank, and cutting the lips thereof. 3d, Such shears, when they also act as benders, to complete the formation of a chair lip, by reason of their having a motion in two directions. 4th, A double or parting clamp and die, so that a chair may be removed from the die upon which it is formed. 5th, Discharging a chair from a double or parting die, or its equivalent, by hooks, or their equivalents, acting to shove the chair off of a die. 6th, In combination, two clamping dies, one of which acts as a former, and divides at proper intervals shears, which also act as benders, or their equivalents, and a discharging apparatus, acting in respect to each other."

4. For an *Improvement in Reaping Machines;* Jonathan Read, Alton, Illinois; patented March 12, 1842; extended March 12, 1856; re-issued August 19, 1856.

Claim.—"1st, The sickle, with its cutting edge when both scolloped and serrated. 2d, Reserving the serration on the edge of the sickle in short sections. 3d, Constructing the guard fingers in the shape of a spear head, for the purpose of affording a shoulder on each edge against which the grain will be held, thus counteracting its tendency to slip from the action of the sickle, and forming an acute-angled space in front of the edge of the sickle to render the severing of the grain more easy and certain."

5. For an *Improvement in Reaping Machines;* Jonathan Read, Alton, Illinois; patented March 12, 1842; extended March 12, 1856; re-issued August 19, 1856.

Claim.—"1st, The combination with the platform of a reaping machine, of a mechanical rake, which traverses said platform at intervals, and draws off the grain gathered thereon. 2d, The combination with a mechanical rake, of the roof or screen, or the equivalent thereof, to intervene and keep the gravel of grain collected on the platform separated during its discharge by the rake from the grain just cut, and falling towards the platform, thereby avoiding the scattering and entanglement which takes place when the grain passing off and that falling upon the platform are not kept separate. 3d, The combination with the roof or screen of a mechanical rake, of a stripper or guard, or its equivalent, to sweep from the screen any grain which may have fallen upon it during the passage of the rake to and fro over the platform. 4th, Constructing the platform

with slats or ribs for the grain to lie on, and intermediate spaces for the teeth of the rake to run in to pass below the grain, and thus avoid all danger of overrunning and imperfectly discharging it."

6. For an *Improvement in Reaping Machines;* Jonathan Read, Alton, Illinois; patented March 12, 1842; extended March 12, 1856; re-issued August 19, 1856.

Claim.—"The combination of the reel for gathering the grain to the cutting apparatus, and depositing it on the platform, with the seat or position for the raker, to enable the raker to ride and rake the grain from the platform, and free the reel and cutting apparatus from obstructions."

7. For an *Improvement in Reaping Machines;* Jonathan Read, Alton, Illinois; patented March 12, 1842; extended March 12, 1856; re-issued August 19, 1856.

Claim.—"In combination with the main frame of the machine hung or balanced on the supporting wheels, and the thills or tongue by which the horses draw the machine hinged to the said frame, a lever connected with, or acting upon one, and extending to the driver's stand or seat on the other, so that the driver, who is the sole conductor of the machine, may, from said stand, by this arrangement, raise or depress the cutter at pleasure during the operation of the machine for cutting grain at any suitable height above the ground, or for passing over any intervening obstacles."

8. For an *Improvement in Harvesting Machines;* Jonathan Read, Alton, Illinois; patented March 12, 1842; extended March 12, 1856; re-issued August 19, 1856.

Claim.—"The arrangement of parts whereby a clear space is obtained, and the grain discharged between the platform and the path of the driving wheel, before the latter has passed the discharged grain."

9. For an *Improved Bomb-Lance for Killing Whales;* Christopher C. Brand, Norwich Connecticut; patented June 22, 1852; re-issued August 26, 1856.

Claim.—"The mode of sustaining the fuse rope in the fuse tube, and preventing the fire of the charge of the gun from passing by the fuse rope, and into the bomb, viz: by metal or metallic plugs, or the equivalents thereof, cast around or made to closely encompass the fuse rope after it has been inserted in the fuse tube. So making or applying them to the shaft shank, or to the body of the bomb, that not only may they be folded or moved down so as to be capable of entering with the shaft the bore of the gun, but each have an elastic property or spring, such as will cause it to unfold or be thrown outward, immediately after the projectile may be discharged from the gun; such wings being made of vulcanized india rubber, or any substance or substances which may be deemed an equivalent thereto, inasmuch as such may possess the requisites."

Designs for August, 1856.

1. For *Cooking Stoves;* N. S. Vedder, Assignor to Cox, Richardson & Boynton, Troy New York.

2. For *Cooking Stoves;* N. S. Vedder and Ezra Ripley, Assignors to Cox, Richardson & Boynton, Troy, New York.

3. For *Parlor Stoves;* David Hathaway, Assignors to Cox, Richardson & Boynton Troy, New York.

4. For *Six Plate Stoves;* N. S. Vedder and Ezra Ripley, Assignors to Swetland & Little, Crescent, New York.

5. For *Cooking Stoves;* N. S. Vedder and Wm. L. Sanderson, Assignors to Swetland & Little, Crescent, New York.

6. For *Cooking Stoves;* N. S. Vedder and Wm. L. Sanderson, Assignors to Swetland & Little, Crescent, New York.

Claims—To the above six patents, are for the ornamental designs, as represented in the drawings.

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

On the Construction of War Steamers.

To the Committee on Publications:

GENTLEMEN:—I wish to draw the attention of the "powers that be," to an useless incumbrance placed on our vessels of war, particularly those propelled by steam; as this retarding force is to be seen on all of the old vessels, it may almost be considered one of the cherished "institutions" of the Navy, yet I for one, think that *progress* should have ere now reformed this; but not so, for the "*Wabash*" is thus disfigured, and as the "*Minnesota*" has pump pipes outside, she no doubt will have the same incumbrance after being coppered.

At the time of building the former vessel, I noticed that the workmen were very particular in smoothing the planking of the bottom, and also that great attention was paid to the coppering, setting it up close to the planking. So far the beautiful formed lines of the Naval Constructor remained perfect; but next comes *four* large lead pipes, one at each quarter, and main chains, and over these more copper was put, projecting about three inches from the plane of the sides, altogether making over *seven and a half square feet of retarding surface under water.*

I will leave to the mathematicians of the Navy to estimate how many *barnacles* studded over the bottom would be equal to the pipes, and how much coal will be required to be carried on a voyage to overcome this worse than useless arrangement, which is an injustice to the Naval Constructor, and the builders of the machinery, who are conjointly responsible for the speed of the ship.

The water for the deck pumps could be obtained from the large pipes passing through the bottom for the supply of the steam engines, and then these lead pipes after being so attached, would be led fore and aft and up to any required point on the deck; so placed they would be more secured from injury and be no drawback. This may be thought a small matter by some, but it is by attention to trifles that perfection results, and in this case a *very slight* difference in speed may be of the utmost consequence in time of war; many things apparently trifling to a landsman, are cared for at sea; thus, rope's ends, &c., are not allowed to tow in the water; and on certain occasions (and very properly) sails are wetted to prevent air passing through the minute interstices of the close woven canvass.

In connexion with the above, I will point out a retarding force common to all side-wheel steamers, that is, placing the after beam too close to the periphery of the wheel, and, as the solid water leaves the paddle at a tangent, it impinges against this beam and re-acts against the wheel; again, there is a loss by there not being sufficient space between the edges of the bucket and the "house," converting it into a "*blower*," and of course consuming power; on the rivers of the West, it is no uncommon thing to have the wheel-house destroyed, and when this happens, the engine of that now always requires to be more "throttle" than before. All of the after part of the wheel-house should be open, with an oblique bulkhead to discharge the water, as is partially practised on some tow-boats.

While in the vein, permit me to write a word about *coal*. After every trial trip of a steamboat, you may read this or a similar sentence, "more speed would have been obtained but for the *inferior* quality of the coal." Strange to say, that on such occasions, although much expense and preparation is made for the inner man, yet the caterer for the food of the boilers always provides "*bad coal*." Now, I contend that the *coal* on a trial-trip always does its duty, for boilers without soot or ashes in the flues, and no sediment or scale inside, will generate steam at that time the freest; it is true that the firemen may not have found out the best method of attending to the furnaces, for each boiler has its peculiarities, but this is a matter which has most to do with economy.

All know that the friction of new machinery at the time of starting, may absorb a large proportion of the power. A long time ago I was present at the starting of a stationary steam engine (by a firm famous for making *too* good fitting machinery), which under a pressure of 150 lbs. of steam to the square inch, and plenty of it, *for the coal was good then*,* the engine *alone* could not be got up to its speed for over half an hour, and yet before a week's running there was not a better performing engine before or since. If all makers of steam engines are not engineers, may not errors of construction have something to do with the disappointment of speed. These, with bad model, incumbrances to sides, &c., may all, or either, prevent the speed desired, *without disparaging the staple production of this State*. J.

* This anthracite coal was mined *up*, and as now the most of the coal in market comes from below the water line it must be better.

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*On a Peculiar Power possessed by Porous Media (Sand and Charcoal) of removing Matter from Solution in Water.** By Henry M. Witt, F.C.S., Assistant Chemist to the Government School of Applied Science.

Communicated by the Author.

Various methods have been employed at different times for the purification of water for the supply of towns, but none has been found so practically convenient and efficacious as simple filtration through porous media, such as sand; moreover, charcoal being known to possess a peculiar power of removing *organic* matters from solution, this substance has been suggested and occasionally employed either as a substitute for, or an auxiliary to, ordinary sand filtration.

The following experiments were undertaken with a view of ascertaining by chemical analysis the more precise nature of the effects produced upon ordinary river-water, such as that of the Thames, by its passage through filters composed of these media respectively, and of comparing their powers; but it is believed that the results obtained possess an interest extending considerably beyond the question to assist in the solution of which they were made.

Before proceeding to the construction of experimental filters, I availed myself of the kindness of Mr. James Simpson, engineer to the Chelsea Water-works Company, to investigate the results obtained by that Company's system of filtration as carried on up to the present time at Chelsea;

* From the Lond., Edin., and Dub. Philos. Mag., July, 1856.

and I have much pleasure in embracing the opportunity of expressing my obligation to this gentleman, and specially also his son, Mr. James Simpson, Jr., to whom I am greatly indebted for his very able co-operation throughout this inquiry.

The system of purification adopted by the Chelsea Water-works Company at their works at Chelsea, consisted hitherto (for the supply has by this time commenced from Kingston) in pumping the water up out of the river into subsiding reservoirs, where it remained for six hours; it was then allowed to run on to the filter beds. These are large beds of sand and gravel, each exposing a filtering surface of about 270 square feet, and the water passes through them at the rate of about $6\frac{1}{4}$ gallons per square foot of filtering surface per hour, making a total quantity of 1687·5 gallons per hour through each filter.

The filters are composed of the following strata in a descending order:

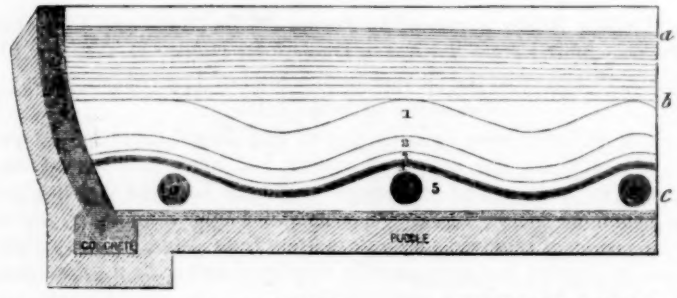
	ft.	in.
No. 1. Fine Sand,	2	6
" 2. Coarser Sand,	1	0
" 3. Shells,	0	6
" 4. Fine Gravel,	0	3
" 5. Coarse Gravel,	3	3

These several layers of filtering materials are not placed perfectly flat, but are disposed in waves, as seen in the sectional drawing; and below the convex curve of each undulation is placed a porous earthenware pipe, which conducts the filtered water into the mains for distribution.

Chelsea Water-works, Thames Bank. Transverse Section of Filter.

Ground line.

Downward Filtration.



a. Water line. b. Top of Fine Sand. c. Collecting drain (perforated).

Note.—Depth of water over the sand = 4 ft. 6 ins.

The upper layer of sand is renewed about every six months, but the body of the filter has been in use for about twenty years.

Samples of water were taken and submitted to examination—

1st. From the reservoir into which the water was at the time being pumped from the middle of the river.

2d. From the cistern after subsidence and filtration.

Experiments of this kind were made on three different occasions, viz: on the 12th of September and the 29th of December, 1855; and also on the 10th of May, 1856; and the results are embodied in Tables I., II., and III., each containing four columns,—No 1 showing the quantities of the several substances originally present, represented in grains in the

imperial gallon (70,000 grains) of water; No. 2, the amounts present after filtration; No. 3, the actual quantities separated in grains in the gallon of water; and No. 4, the per centage ratio which the amounts separated bear to the quantities originally present.

Results of Filtration through Sand at the Chelsea Water-works.

TABLE I.—September 12, 1855.

	1. Originally present.	2. Present after filtration.	3. Amount separated.	4. Per centage ratio of separated matter.
Total solid residue (including suspended matter,)	65·527	41·290	24·237	36·98
Organic matter,	1·240	0·674	0·566	45·63
Total mineral matter,	64·287	40·616	23·671	36·82
Suspended matter,	16·112	....	nearly	all.
Total soluble salts,	48·175	40·616	7·559	15·69
Chlorine,	12·240	11·140	1·100	
Chloride of sodium,	20·170	18·357	1·820	9·23

TABLE II.—December 29, 1855.

	1. Originally present.	2. After filtration.	3. Amount separated.	4. Per centage ratio of separated matter.
Total solid residue (including suspended matter)	31·467	24·153	7·314	23·24
Organic matter,	2·375	1·889	0·486	20·46
Total mineral matter,	29·092	22·264	6·828	23·47
Suspended matter,	7·035	1·403	5·632	80·05
Total dissolved salts,	22·057	20·861	1·196	5·42
Lime,	8·675	8·402	0·273	3·14
Chlorine,	1·667	1·546	0·121	7·25
Chloride of sodium,	2·747	2·547	0·200	7·28
Sulphuric acid,	2·962	2·372	0·590	19·92

TABLE III.—May 10, 1856.

	1. Originally present.	2. After filtration.	3. Amount separated.	4. Per centage ratio of separated matter.
Total solid residue (including suspended matter,)	55·60	22·85	32·75	58·90
Organic matter,	4·05	1·349	2·70	66·66
Total mineral matter,	51·55	21·501	30·049	58·29
Suspended matter,	28·93	2·285	26·645	92·10
Total dissolved salts,	22·62	19·216	3·404	15·04
Lime,	8·719	8·426	0·293	3·36

By these analytical results (if entitled to confidence, and I may state that all due care and attention were given to ensure their accuracy) it is shown that this process of mere sand filtration is one of more importance, and of a more peculiar and interesting character, than has generally been supposed.

It has been asserted as a principle that sand filtration *can* only remove bodies mechanically suspended in water, but I am not aware that this statement has been established by experiment; in fact, I am not acquainted with any published analytical examination of the effects of sand filtration.

These experiments supply the deficiency, and show moreover, that these porous media are not only capable of removing suspended matter (80 to 92 per cent.), but even of separating a *certain appreciable quantity of the* SALTS *from* SOLUTION *in water!* viz: from 5 to 15 per cent. of the amount originally present, 9 to 19 per cent. of the common salt, 3 per cent. of the lime, and 5 per cent of the sulphuric acid.

It is curious also, that the proportion of matter removed in this way depends to a certain extent upon the degree of impurity of the water; the greater the quantity of matter originally present in the water, the larger the per centage ratio of the salts removed, *e. g.*:—

	In Sept.	In Dec.	In May.
Total impurity of water, . .	65·527	31·467	55·90
Per centage of salts removed, . .	15·69	5·42	15·04

This point will, however, become more apparent by comparing these experiments with those made at Kingston, where the water is much purer, to which I shall have occasion hereafter more particularly to refer.

This fact, of the power possessed by sand and other porous media, which rests for demonstration not only upon the three preceding experiments, but also upon others to be presently described, is one of great importance, not only in a hygienic and economic point of view as relating to the great question of water supply, but also in its bearings upon agriculture and geology.

It is possible that soils may remove matters from solution in water, not only by decompositions between the contained salts and the aluminous silicates of the soil, (as demonstrated by Mr. Way,) but also in virtue of this peculiar action.

Again, water containing considerable quantities of saline matter in solution may, by merely percolating through *great masses* of porous strata during *long periods*, be gradually deprived of its salts to such an extent as probably to render even sea-water fresh.

This may, in fact, be one of the causes contributing towards the production of fresh water springs which ebb and flow with the tide in the vicinity of the sea: for instance, Darwin, in the "Voyage of the Beagle" (vol. iii. p. 545), mentions that on Keeling Island, one of the coral reefs near the coast of Sumatra, there are fresh water wells which ebb and flow with the tide. Mr. Darwin, however, suggests another explanation of this phenomenon; he says that "at first sight it would appear not a little remarkable that the fresh water should regularly ebb and flow with the tide. We must believe that the compressed sand or porous coral rock acts like a sponge, and that the rain-water which falls on the ground being specifically lighter than salt, floats on its surface, and is subject to the same movements. There can be no actual attraction between salt and fresh water, and the spongy texture must tend to prevent all admixture from slight disturbances. On the other hand, where the foundation consists only of loose fragments, upon a well being dug, salt or brackish water enters, of which fact we saw an instance on this small island."

Now I would not presume to deny the accuracy of this explanation; still it is possible that the phenomenon may be a mixed one, and that the peculiar power which I have found to be possessed by porous media may contribute towards the result by abstractiug a portion (at least) of the salts from the sea-water during its passage through the porous rock.

Moreover, there are certain difficulties in Mr. Darwin's explanation. If the sand did not possess the power of removing salts from solution, to a certain extent at all events, the rain-water inside would tend, more or less rapidly, to become salt by the commixture with it of the sea-water from without, which would take place through the porous diaphragm so much the more readily on account of their difference of density, in virtue of the "osmotic force" so ably investigated by Professor Graham. Indeed, the last fact mentioned by Mr. Darwin, viz: that when the wall consists of loose fragments the wells are salt, tends to show that it is only the very finely divided sand, the porous medium offering a considerable extent of surface, which possesses the power of removing the salts, for if the non-commixture of the salt and fresh water arose only from their difference of density, the coarseness of the diaphragm would not materially affect it.

As to the *cause* of this peculiar action, the only suggestion which I may venture to offer is, that it possibly arises from the weak chemical affinity in virtue of which salts are held in solution in water, being overcome by a physical force, the attraction of cohesion, or more properly adhesion, exerted by the greatly extended surface of the porous body; this is not a solitary instance of such weak chemical forces as solution being overcome by a physical attraction. Gmelin* instances several other examples of the power of the physical force of "*adhesion*" to overcome weak chemical attractions, *e. g.*: "When vinegar is filtered through quartz sand, the first portion of liquid that runs through is robbed of almost all its acid, and the vinegar does not pass through unchanged until the sand has become well charged with acid. Potato brandy diluted with water, and filtered through quartz sand, yields at first pure water, then a mixture of water and alcohol deprived of its fusel oil, and lastly, the original mixture unaltered: wood shavings also deprive vinegar of nearly all its acid; charcoal acts still more powerfully.†

Now it is possible that these being organic compounds they may be oxidized, even into carbonic acid and water, under these circumstances; but whatever difference of opinion may arise respecting the *cause*, this cannot affect the simple experimental fact.

It will naturally be asked, if sand possess this power, Are not the salts removed from the water accumulated in the sand, and would not this throw light upon the mode of formation of sandstone conglomerate rocks? To enable me to reply to this question, I have in my possession samples of sand, before use, and also after employment in the middle of the filter at Chelsea for no less than twenty years, and their analysis will form the subject of a future communication; pressure of other duties having hitherto prevented me from the completion of this important point in the inquiry.

But, as before mentioned, the preceding are not the only experiments which I have made on this subject: the following were performed at

* Handbook of Chemistry, Cavendish Society's Translation, vol. i. p. 114.

† Wagenmann, Poggendorff's *Annalen*, xxiv. 600.

Kingston, where the water is far purer, more particularly for the purpose of ascertaining the effects of charcoal and comparing its powers with those of sand.

At the time these experiments were in progress, the Company's filter-beds at Kingston, now just completed, were finished, and consequently, in order to ascertain the effects both of sand and charcoal on the comparatively pure water of Kingston, it became necessary to construct smaller experimental filters.

The earlier experiments were upon the effects of charcoal, and several preliminary trials were made for the purpose of ascertaining the form of filter and rate of filtration which would nearest approximate to the operation as carried on on the large scale.

In the first of these experiments, to which attention may be drawn, the water was pumped from the river into a cistern of slate, where a deposition of the greater portion of the suspended matter took place; it was then conducted into the upper part of the right-hand compartment of a nearly cubical wooden cistern, this right-hand compartment being separated from the one on the left by a porous diaphragm, the walls of which were of wire gauze, and the interior filled with fragments of oak charcoal, about the size of a hazel nut to a walnut: this charcoal diaphragm exposed a filtering surface of about 5·38 square feet; the filtration was lateral and descending, the water entering at the upper part of the right-hand compartment, and passing out at the lower extremity of the left-hand division; the rate of filtration being half a gallon per minute.

A sample of the water was analyzed before passing into the filter, and after coming from it, after the continuance of the operation for a certain number of hours. The results were as follows:

TABLE IV.

	Original water used.	After 67 hours action.			After 91 hours action.		
		Comparison.	Amount separated.	Per centage ratio of quantity separated.	Comparison.	Amount separated.	Per centage ratio of quantity separated.
Total residue, .	23·949	23·668	0·281	1·17	22·076	1·873	7·82
Mineral salts, . .	22·519	....	....	....	21·618	0·901	4·00
Organic matter, .	1·430	0·475	0·955	66·78	0·458	0·972	68·00
Chlorine, . . .	1·054	....	....	....	0·9731	0·081	7·685
Chloride of sodium	1·737	....	....	....	1·603	0·134	7·714
		After 115 hours action.			After 139 hours action.		
Total residue, .	23·949	23·012	0·937	3·91	23·411	0·538	2·242
Mineral salts, . .	22·519	....	....	....	22·44	0·079	3·66
Organic matter,	1·430	0·620	0·810	56·67	0·971	0·459	32·10
Chlorine, . . .	1·054	0·885	0·169	16·03	0·973	0·081	9·73
Chloride of sodium	1·737	1·457	0·280	16·10	1·603	0·134	9·8

This experiment exhibits more strikingly perhaps than any of the others, the very curious circumstance that in the employment of charcoal the amount of impurity separated by it goes on increasing to a certain point, and then diminishes; to which, however, I must again more particularly allude after describing the experiment comparing sand and charcoal, simultaneously; it demonstrates also very satisfactorily the power possessed

by charcoal, like sand, of removing not only suspended matters, but also soluble salts, *e. g.* chloride of sodium: but to this point I shall again refer.

Although very satisfactory as showing the power of charcoal under the circumstances of the experiment, yet it being probable that by employing the charcoal in lumps, as was done, it had not a fair chance of exhibiting its peculiar properties, inasmuch as only very imperfect contact was effected between the impurities contained in the water and the particles of charcoal, it was resolved to try an experiment with charcoal in powder, or nearly so, in granules of the size of a pea. Moreover, even then we should have succeeded only in proving the *absolute* effect of charcoal, for we have learnt that the results thus obtained did not admit of comparison with those of filtration through sand at Chelsea, on account of the great difference in the original composition of the water; therefore, in order to establish at the same time the absolute effect of charcoal as a filtering medium upon the purer water at Kingston, and also to compare it with that of sand, two experiments were made simultaneously with the same water, the one of filtration through charcoal alone, and the other through sand alone, both under precisely similar circumstances. In both these experiments the filtration was not effected laterally as in the foregoing case, but *downwards* in the usual way through beds of the same size of the respective filtering media contained in wooden troughs, the water being admitted at the top and passing off from below.

The sand-filter had an area of 4 square feet, and consisted of the following materials:—

	ft.	ins.
Fine sand, ...	1	9
Shells, ...	0	1½
Gravel, ...	0	1½
Coarse Gravel, . . .	0	9
	2	9

The rate of filtration being half a gallon per minute.

TABLE V.—*Results of Sand Filtration.*

	Original water used.	After 23 hours action.			After 120 hours action.		
		Comparison.	Amount separated.	Per centage ratio of quantity separated.	Comparison.	Amount separated.	Per centage ratio of quantity separated.
Total residue, .	24·578	23·87	0·708	2·88	23·69	0·888	3·613
Mineral salts, . .	23·687	22·858	0·829	3·50	23·04	0·647	2·73
Organic matter, .	0·8906	1·012	. . . .	. . . .	0·648	0·2426	
Suspended matter,	3·509	2·663	0·846	24·109			
Chlorine, . . .	0·862	. . . .	. . . .	. . . .	0·671	0·191	22·16
Chloride of sodium	1·420	. . . .	. . . .	. . . .	1·105	0·315	22·11
		After 240 hours action.			After 376 hours action.		
Total residue, .	24·578	22·534	2·044	8·316	22·507	2·071	8·426
Mineral salts, . .	23·687	21·517	2·170	9·161	21·698	1·989	8·397
Organic matter, .	0·8906	0·915	. . . .	. . . .	8·809		
Suspended matter,	3·509	1·88	1·629	46·423	1·584	1·925	54·85
Chlorine, . . .	0·862	0·674	0·188	21·8			
Chloride of sodium,	1·420	1·110	0·310	21·8			

Apart from its special interest, as compared with the following experi-

ment made simultaneously through charcoal, the following points are in themselves remarkable in the results obtained by this filtration through sand:—

1st. That the filter continued increasing in efficacy even till the conclusion of the experiment, *i. e.* for 376 hours, not having lost any of its power when the experiment was terminated.

2d. That no weighable quantity of dissolved organic matter was removed by the sand in this experiment; but it must be remembered that the quantity originally present was but small.

3d. Its power of removing soluble salts was considerable; as a maximum, 21 per cent. of the common salt being separated.

TABLE VI.—*Results of Charcoal Filtration.*

	Original water used.	After 72 hours action.			After 120 hours action.		
		Comparison.	Amount separated.	Per centage ratio of quantity separated.	Comparison.	Amount separated.	Per centage ratio of quantity separated.
Total residue, .	24·578	22·13	2·448	9·906	21·644	2·934	11·93
Mineral matter, .	23·687	21·375	2·312	9·76			
Organic matter, .	0·8906	0·755	0·1356	15·22			
Suspended matter,	3·509	....	....	....	3·06	0·449	12·79
Chlorine, . . .	0·862						
Chloride of sodium,	1·420						

		After 240 hours action.			After 376 hours action.		
Total residue, .	24·578	20·821	3·757	15·28	21·374	3·204	13·03
Mineral matter, .	23·687	....	....	....	20·604	3·033	12·34
Organic matter, .	0·8906	....	....	....	0·770	0·1206	13·54
Suspended matter,	3·509	2·79	0·719	20·48			
Chlorine, . . .	0·862						
Chloride of sodium,	1·420						

On comparing this experiment with the preceding, the following points come out as showing the difference between the effects of sand and charcoal as filtering media.

1st. By the charcoal, speaking generally, a considerably larger quantity of the total residue contained in the water was removed than by the sand, their maximum results being respectively as follows:—

Amount originally present.	Amount separated in grains in the gallon.		Amount separated in per centage of the quantity present.	
	By sand.	By charcoal.	By sand.	By charcoal.
24·578 grs. in the gallon.	2·074	3·757	8·426	15·28

But, as might have been anticipated from the well-known power of charcoal to remove organic principles from solution in water, its superiority over sand is more especially observable in this respect; no weighable quantity of organic matter being separated by the sand, whilst 15 per cent. of the quantity present was removed by the charcoal.

Nevertheless the case is quite altered when more impure water is filtered through the same medium; for instance, it will be remembered that sand does remove organic matter from water when the quantity present is somewhat greater. Thus, in Tables I., II., and III., it is shown that at Chelsea, where the quantity of organic matter present in the water rose to 2·375 grs. in the gallon, then the sand removed 20·46 per cent.; when the quantity present amounted to 4·05 grs. 66·66 per cent.; and lastly, when to 9·909 grs., no less than 95·23 per cent. was removed!

Now this is a most striking and important result in a hygienic point of view. The evil consequences said to result from the water supply of London at present in use are mainly attributed to the organic matter present in the water; but these analyses show that the more impure the water (within certain limits), the greater is the power of porous filtering media to remove these impurities, probably from the more perfect contact between the filtering medium and the impurities present. It is obvious that this would not go on *ad infinitum;* it must not be supposed that I wish it to be inferred that the more organic matter there is present in a water, the more would necessarily be removed by sand filtration; quite the contrary, it is highly probable that if the quantity had increased much beyond what was contained at the time of the performance of these experiments, a considerable amount might have passed through unrestrained; all I wish to be understood is, that *within the limits of the quantities present* when these experiments were made, *sand was found incapable* of removing any appreciable quantity of organic matter when the amount originally present in the water was *exceedingly small;* but that in the same ratio as the quantity present increased, the *proportion separated rose.*

Now the power of charcoal, I believe, increases in a similar manner; but no experiments could conveniently be made on the large scale at Chelsea to enable me to draw a strict comparison between the effects of sand and charcoal upon the more impure water there, similar to what had been made at Kingston with the comparatively pure water; therefore to enable me to adduce experimental evidence on this point, a comparative experiment was made on the small scale with an artificially prepared impure water.

This water was prepared as follows:—To the sample of Thames water collected at Kingston on the 8th of October, 1855, cow-dung and garden mould were added, in the proportion of 4 ozs. of solid cow-dung (without straw) and 4 ozs. of garden mould to two gallons of the water; the whole was allowed to digest for a week, being frequently shaken during this period; it was then allowed to settle for twelve hours, and the supernatant fetid fluid poured off and submitted to examination. It was found to contain in the gallon—

Total residue, . . .	71·772 grs.
Organic matter, . . .	29·308 "
Mineral matter, . . .	42·468 "

And the results obtained by filtration respectively through sand and charcoal are contained in the following Tables:—

TABLE VII.—*Action of Vegetable Charcoal on Artificially Impure Water.*

	Original constituents.	Present after filtration.	Amount separated in grains in the gallon.	Per centage ratio of matter separated.
Total residue,	71·772	33·86	37·912	52·82
Organic matter,	29·308	3·50	25·808	88·05
Mineral salts,	42·464	30·36	12·104	28·26

TABLE VIII.—*Action of Sand.*

	Original constituents.	Present after filtration.	Amount separated in grains in the gallon.	Per centage ratio of matter separated.
Total residue,	71·772	70·23	1·542	2·14
Organic matter,	29·308	27·85	1·458	4·97
Mineral salts,	42·464	42·38	0·084	0·197

It must be borne in mind that these two experiments being made only on the small scale in the laboratory, though strictly comparable with each other, do not admit of comparison with any of the others; they serve only to demonstrate how far greater is the power possessed by charcoal of removing organic matters from solution than that of sand, though the difference in their action on soluble inorganic salts is less marked.

Another point of distinction between the effects of charcoal and sand upon the Thames water at Kingston was this—that whereas the efficacy of the sand-filter continued increasing even up to the conclusion of the experiment, the amount of impurity separated by the charcoal arrived in all cases at a maximum after a certain number of hours, and then began to decrease, as will be more perspicuously shown by the following Table:—

TABLE IX.—*Showing the period of maximum efficacy of the several filters.*

Amounts of total residue originally present in each case.	Number of hours action of the filter	Amount separated in grains in the gallon by			Per centage ratio of quantity separated by		
		Sand.	Charcoal in granules.	Charcoal in lumps.	Sand.	Charcoal in granules.	Charcoal in lumps.
grs.	hrs.						
24·578	23	0·708	2·868	....	2·88	11·66	
23·949	67	..	....	0·281	..	....	1·17
23·949	91	..	....	1·873	..	....	7·82
23·949	115	..	....	0·937	...	....	3·91
24·578	120	0·888	2·934	....	3·613	11·93	
23·949	139	..	....	0·538	...	....	2·242
24·578	240	2·044	3·757	....	8·316	15·28	
24·578	376	2·071	3·204	....	8·426	13·03	

Lastly, these experiments upon the comparatively pure water of Kingston, show that CHARCOAL, *as well as sand*, is capable of separating *mineral* salts from *solution* in water, as is evident by an inspection of the foregoing Tables.

The following is a brief summary of the most important results of this investigation:—It has been shown,—

1st. That sand, charcoal, and probably other porous media, possess the

very peculiar property of removing, not merely suspended impurities, but even dissolved salts from solution in water.

2d. That charcoal enjoys pre-eminently the power of abstracting organic matter from solution; but that even sand likewise is capable of effecting the same result, though to a far less extent.

3d. That these powers, possessed by both these media, increase in intensity to a certain extent with the degree of impurity of the solution.

4th. That these properties of porous media have important bearings upon hygienic science, agricultural principles, and geological phenomena.

The reader will not fail to have noticed, by the various analyses given above, great variations in the composition of the river-water, between the two points at which experiments were made, viz: at Chelsea and Kingston, as well as at the different seasons of the year. To a number of analyses made during the year since May 1855, I hope to draw attention in a subsequent paper as elucidating these facts.

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*On the Manufacture of Malleable Iron and Steel without Fuel.**

By H. Bessemer.

"The manufacture of iron in this country has attained such an important position that any improvement in this branch of our national industry cannot fail to be a source of general interest, and will, I trust, be a sufficient excuse for the present brief, and, I fear, imperfect paper. I may mention that for the last two years my attention has been almost exclusively directed to the manufacture of malleable iron and steel, in which, however, I had made but little progress until within the last eight or nine months. The constant pulling down and re-building of furnaces, and the toil of daily experiments with large charges of iron, had already begun to exhaust my stock of patience; but the numerous observations I had made during this very unpromising period, all tended to confirm an entirely new view of the subject, which at that time forced itself upon my attention—viz: that I could produce a much more intense heat without any furnace or fuel than could be obtained by either of the modifications I had used, and consequently that I should not only avoid the injurious action of mineral fuel on the iron under operation, but that I should at the same time avoid also the expense of the fuel. Some preliminary trials were made on from 10 lbs. to 20 lbs. of iron, and, although the process was fraught with considerable difficulty, it exhibited such unmistakable signs of success as to induce me at once to put up an apparatus capable of converting about 7 cwt. of crude pig-iron into malleable iron in 30 minutes. With such masses of metal to operate on, the difficulties which beset the small laboratory experiments of 10 lbs., entirely disappeared. On this new field of inquiry I set out with the assumption that crude iron contains about 5 per cent. of carbon; that carbon cannot exist at a white heat in the presence of oxygen without uniting therewith and producing combustion; that such combustion would proceed with a rapidity dependent on the amount of surface of carbon exposed; and, lastly, that the temperature which the metal would acquire would be also dependent on the rapidity with which the oxygen and

*From the Lond. Civ. Eng. and Arch'a. Jour., Sept., 1856.

carbon were made to combine, and consequently that it was only necessary to bring the oxygen and carbon together in such a manner that a vast surface should be exposed to their mutual action, in order to produce a temperature hitherto unattainable in our largest furnaces. With a view of testing practically this theory, I constructed a cylindrical vessel of three feet in diameter and five feet in height, somewhat like an ordinary cupola furnace, the interior of which is lined with fire bricks, and at about two inches from the bottom of it I inserted five tuyere pipes, the nozzles of which are formed of well-burnt fire clay, the orifice of each tuyere being about three-eighths of an inch in diameter; they are so put into the brick lining (from the outer side) as to admit of their removal and renewal in a few minutes when they are worn out. At one side of the vessel, about half way up from the bottom, there is a hole made for running in the crude metal, and on the opposite side there is a tap-hole stopped with loam, by means of which the iron is run out at the end of the process. In practice this converting vessel may be made of any convenient size, but I prefer that it should not hold less than one, nor more than five tons, of fluid iron at each charge. The vessel should be placed so near to the discharge hole of the blast furnace as to allow the iron to flow along the gutter into it; a small blast cylinder will be required capable of compressing air to about 8 lbs. or 10 lbs. to the square inch. A communication having been made between it and the tuyeres before named, the converting vessel will be in a condition to commence work; it will, however, on the occasion of its first being used after relining with fire-bricks, be necessary to make a fire in the interior with a few baskets of coke, so as to dry the brick-work and heat up the vessel for the first operation, after which the fire is to be all carefully raked out at the tapping hole, which is again to be made good with loam. The vessel will then be in readiness to commence work, and may be so continued without any use of fuel until the brick lining in the course of time becomes worn away and a new lining is required. I have before mentioned that the tuyeres are situated nearly close to the bottom of the vessel; the fluid metal will therefore rise some 18 inches or 2 feet above them. It is therefore necessary, in order to prevent the metal from entering the tuyere holes, to turn on the blast before allowing the fluid crude iron to run into the vessel from the blast furnace. This having been done, and the fluid iron run in, a rapid boiling up of the metal will be heard going on within the vessel, the metal being tossed violently about and dashed from side to side, shaking the vessel by the force with which it moves. From the throat of the converting vessel, flame will then immediately issue, accompanied by a few bright sparks. This state of things will continue for about fifteen or twenty minutes, during which time the oxgen in the atmospheric air combines with the carbon contained in the iron, producing carbonic acid gas, and at the same time evolving a powerful heat. Now, as this heat is generated in the interior of, and is diffused in innumerable fiery bubbles through, the whole fluid mass, the metal absorbs the greater part of it, and its temperature becomes immensely increased, and by the expiration of the fifteen or twenty minutes before named that part of the carbon which appears mechanically mixed and diffused through the crude iron has been entirely consumed. The temperature, however,

is so high that the chemically combined carbon now begins to separate from the metal, as is at once indicated by an immense increase in the volume of flame rushing out of the throat of the vessel. The metal in the vessel now rises several inches above its natural level, and a light frothy slag makes its appearance, and is thrown out in large foam-like masses. This violent eruption of cinder generally lasts about five or six minutes, when all further appearance of it ceases, a steady and powerful flame replacing the shower of sparks and cinder which always accompanies the boil. The rapid union of carbon and oxygen which thus takes place adds still further to the temperature of the metal, while the diminished quantity of carbon present allows a part of the oxygen to combine with the iron, which undergoes combustion and is converted into an oxide. At the excessive temperature that the metal has now acquired the oxide as soon as formed undergoes fusion, and forms a powerful solvent of those earthy bases that are associated with the iron. The violent ebullition which is going on mixes most intimately the scoria and metal, every part of which is thus brought in contact with the fluid oxide, which will thus wash and cleanse the metal most thoroughly from the silica and other earthy bases which are combined with the crude iron, while the sulphur and other volatile matters which cling so tenaciously to iron at ordinary temperatures are driven off, the sulphur combining with the oxygen and forming sulphurous acid gas. The loss in weight of crude iron during its conversion into an ingot of malleable iron was found on a mean of four experiments to be 12½ per cent., to which will have to be added the loss of metal in the finishing rolls. This will make the entire loss probably not less than 18 per cent., instead of about 28 per cent., which is the loss on the present system. A large portion of this metal is, however, recoverable by treating with carbonaceous gases the rich oxide thrown out of the furnace during the boil. The slags are found to contain innumerable small grains of metallic iron, which are mechanically held in suspension in the slags, and may be easily recovered. I have before mentioned that after the boil has taken place a steady and powerful flame succeeds, which continues without any change for about ten minutes, when it rapidly falls off. As soon as this diminution of flame is apparent, the workmen will know that the process is completed, and that the crude iron has been converted into pure malleable iron, which he will form into ingots of any suitable size and shape by simply opening the tap-hole of the converting vessel and allowing the fluid malleable iron to flow into the iron ingot moulds placed there to receive it. The masses of iron thus formed will be perfectly free from any admixture of cinder, oxide, or other extraneous matters, and will be far more pure and in a forwarder state of manufacture than a pile formed of ordinary puddle bars. And thus it will be seen that by a single process, requiring no manipulation or particular skill, and with only one workman, from three to five tons of crude iron passes into the condition of several piles of malleable iron in from thirty to thirty-five minutes, with the expenditure of about one-third part the blast now used in a finery furnace with an equal charge of iron, and with the consumption of no other fuel than is contained in the crude iron. To those who are best acquainted with the nature of fluid iron it may be a matter

of surprise that a blast of cold air forced into melted crude iron is capable of raising its temperature to such a degree as to retain it in a perfect state of fluidity after it has lost all its carbon, and is in the condition of malleable iron, which in the highest heat of our forges only becomes softened into a pasty mass. But such is the excessive temperature that I am enabled to arrive at with a properly shaped converting vessel and a judicious distribution of the blast, that I am enabled not only to obtain the fluidity of the metal, but to create so much surplus heat as to re-melt the crop ends, ingot runners, and other scrap that is made throughout the process, and thus bring them without labor or fuel into ingots of quality equal to the rest of the charge of new metal. For this purpose a small arched chamber is formed immediately over the throat of the converting vessel, somewhat like the tunnel head of the blast furnace. This chamber has two or more openings on the sides of it, and its floor is made to slope downwards to the throat. As soon as a charge of fluid malleable iron has been drawn off from the connecting vessel, the workmen will take the scrap intended to be worked into the next charge, and proceed to introduce the several pieces into the small chamber, piling them up around the opening of the throat. When this is done he will run his charge of crude metal, and again commence the process. By the time the boil commences the bar ends or other scrap will have acquired a white heat, and by the time it is over most of them will have been melted and run down into the charge. Any pieces, however, that remain may then be pushed in by the workman, and by the time the process is completed they will all be melted, and ultimately combined with the rest of the charge, so that all scrap iron, whether cast or malleable, may thus be used up without any loss or expense. As an example of the power that iron has of generating heat in this process, I may mention a circumstance that occurred to me during my experiments; I was trying how small a set of tuyeres could be used; but the size chosen proved to be too small, and after blowing into the metal for one hour and three-quarters I could not get up heat enough with them to bring on the boil. The experiment was therefore discontinued, during which time two-thirds of the metal solidified and the rest was run off. A larger set of tuyere pipes were then put in, and a fresh charge of fluid iron run into the vessel, which had the effect of entirely re-melting the former charge, and when the whole was tapped out it exhibited as usual that intense and dazzling brightness peculiar to the electric light.

"To persons conversant with the manufacture of iron it will be at once apparent that the ingots of malleable metal which I have described will have no hard or steely parts, such as is found in puddle iron, requiring a great amount of rolling to blend them with the general mass, nor will such ingots require an excess of rolling to expel cinder from the interior of the mass, since none can exist in the ingot, which is pure and perfectly homogeneous throughout, and hence requires only as much rolling as is necessary for the development of fibre; it therefore follows that, instead of forming a merchant bar or rail by the union of a number of separate pieces welded together, it will be far more simple and less expensive to make several bars or rails from a single ingot; doubtless this would have been done long ago had not the whole process been limited by the size of the ball which the puddler could make.

"The facility which the new process affords of making large masses will enable the manufacturer to produce bars that on the old mode of working it was impossible to obtain; while, at the same time, it admits of the use of some powerful machinery whereby a great deal of labor will be saved, and the process be greatly expedited. I merely mention this fact in passing, as it is not my intention at the present moment to enter upon any details of the improvements I have made in this department of the manufacture, because the patents which I have obtained for them are not yet specified. Before, however, dismissing this branch of the subject, I wish to call the attention of the meeting to some of the peculiarities which distinguish cast steel from all other forms of iron, namely, the perfect homogeneous character of the metal, the entire absence of sand cracks or flaws, and its greater cohesive force and elasticity as compared with the blister steel from which it is made, qualities which it derives solely from its fusion and formation into ingots, all of which properties malleable iron acquires in like manner by its fusion and formation into ingots in the new process. Nor must it be forgotten that no amount of rolling will give to blister steel (although formed of rolled bars) the same homogeneous character that cast steel acquires by a mere extension of the ingot to some 10 or 12 times its original length.

"One of the most important facts connected with the new system of manufacturing malleable iron is, that all the iron so produced will be of that quality known as charcoal iron, not that any charcoal is used in its manufacture, but because the whole of the processes following the smelting of it are conducted entirely without contact with or the use of any mineral fuel; the iron resulting therefrom, will, in consequence, be perfectly free from those injurious properties which that description of fuel never fails to impart to iron that is brought under its influence. At the same time this system of manufacturing malleable iron offers extraordinary facility for making large shafts, cranks, and other heavy masses; it will be obvious that any weight of metal that can be founded in ordinary cast iron by the means at present at our disposal may also be founded in molten malleable iron, and be wrought into the forms and shapes required, provided that we increase the size and power of our machinery to the extent necessary to deal with large masses of metal. A few minutes' such reflection will show the great anomaly presented by the scale on which the consecutive processes of iron-making are at present carried on. The little furnaces originally used for smelting ore have from time to time increased in size, until they have assumed colossal proportions, and are made to operate on 200 or 300 tons of material at a time, giving out 10 tons of fluid metal at a single run. The manufacturer has thus gone on increasing the size of his smelting furnaces, and adapting to their use the blast apparatus of the requisite proportions, and has, by this means, lessened the cost of production in every way; his large furnaces require a great deal less labor to produce a given weight of iron than would have been required to produce it with a dozen furnaces, and in like manner he diminishes his cost of fuel blast and repairs, while he insures a uniformity in the result that could never have been arrived at by the use of a multiplicity of small furnaces. While the manufacturer has shown himself fully alive to these advantages, he has still been

under the necessity of leaving the succeeding operations to be carried out on a scale wholly at variance with the principles he has found so advantageous in the smelting department. It is true that hitherto no better method was known than the puddling process, in which from 400 to 500 weight of iron is all that can be operated upon at a time, and even this small quantity is divided into homœopathic doses of some 70 lbs. or 80 lbs., each of which is moulded and fashioned by human labor, carefully watched and tended in the furnace, and removed therefrom one at a time to be carefully manipulated and squeezed into form. When we consider the vast extent of manufacture, and the gigantic scale on which the early stages of progress is conducted, it is astonishing that no effort should have been made to raise the after processes somewhat nearer to a level commensurate with the preceding ones, and thus rescue the trade from the trammels which have so long surrounded it.

"Before concluding these remarks I beg to call your attention to an important fact connected with the new process, which affords peculiar facilities for the manufacture of cast steel.

"At the stage of the process immediately following the boil, the whole of the crude iron has passed into the condition of cast steel of ordinary quality; by the continuation of the process the steel so produced gradually loses its small remaining portion of carbon, and passes successively from hard to soft steel, and from soft steel to steely iron, and eventually to very soft iron; hence at a certain period of the process any quality of metal may be obtained; there is one in particular, which by way of distinction I call semi-steel, being in hardness about midway between ordinary cast steel and soft malleable iron. This metal possesses the advantage of much greater tensile strength than soft iron; it is also more elastic, and does not readily take a permanent set, while it is much harder and is not worn or indented so easy as soft iron; at the same time it is not so brittle or hard to work as ordinary cast steel. These qualities render it eminently well adapted to purposes where lightness and strength are specially required, or where there is much wear, as in the case of railway bars, which from their softness and lamellar texture soon become destroyed. The cost of the semi-steel will be a fraction less than iron, because the loss of metal that takes place by oxidation in the converting vessel is about 2½ per cent. less than it is with iron; but, as it is a little more difficult to roll, its cost per ton may fairly be considered to be the same as iron; but, as its tensile strength is some 30 or 40 per cent. greater than bar iron, it follows that for most purposes a much less weight of metal may be used, so that taken in that way the semi-steel will form a much cheaper metal than any we are at present acquainted with.

"In conclusion, allow me to observe that the facts which I have had the honor of bringing before the meeting have not been elicited from mere laboratory experiments, but have been the result of working on a scale nearly twice as great as is pursued in our largest iron works, the experimental apparatus doing 7 cwt. in 30 minutes, while the ordinary puddling furnace makes only 4½ cwt. in two hours, which is made into six separate balls, while the ingots or blooms are smooth, even prisms, 10 inches square, by 30 inches in length, weighing about equal to ten ordinary puddle balls."

Mr. Bessemer's process has, since the reading of his paper before the British Association, been put to a severe practical test, with the most successful result, at Baxter house, St. Pancras road, in the presence of several iron masters, practical engineers, and scientific men resident in the metropolis.

Men like the two Rennies, Nasmyth, and others of minor note, but of great experience as engineers and iron manufacturers, have pronounced emphatically and without qualification in its favor, whilst some, including Nasmyth, declare themselves unable to foresee the whole of the advantageous results, calculated to spring from its discovery, not to this country alone, but wherever else it may be brought into use.

In conducting the demonstration, 6 cwt. 3 qrs. 18 lbs. of molten iron from a furnace was poured into the fire-brick vessel, already described, at twelve minutes past one o'clock, the blast having been applied at a pressure about 8 lbs. per square inch, and continued until twenty-seven minutes past one. The mass of metal began to boil up, and the cinders and other impurities were extruded from the top of the vessel by two apertures provided for the purpose. Showers of brilliant sparks were thrown off during this process, which lasted several minutes; and as the object was to produce a mass of cast steel, rather than continue the process to the extent necessary for making pure iron free from carbon, the vessel was tapped at thirty-six minutes past one and the contents drawn off. Small specimen ingots being first taken, the general mass was run into an ingeniously contrived mould concealed in the floor in front of the apparatus, and, after remaining there a few minutes, cooling down, it was raised out of the mould in a red-hot state by an hydraulic ram, and placed upon a weighing machine. The ingot thus produced, with the two specimen ingots, weighed 6 cwt. Without the aid of fuel, this mass of material was converted in twenty-four minutes from crude cast iron as it comes from the blast furnace, into steel of fine quality.

The experiment was unanimously pronounced by the company to be perfectly satisfactory. It is a peculiar and important feature in the process, that by continuing the boiling a few minutes longer the whole of the carbon still remaining in the mass of metal, and which gives to it the character known as steel, would have been drawn off, and a pure mass of crystalline iron would have been the result.

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*Mr. Bessemer's Discovery.** By C. Sanderson, of Sheffield.

The metallurgical world has been paralyzed not only by the statement set forth at the meeting of the British Association, at Cheltenham, but by the details given in the *Times* of a trial made in London to exhibit Mr. Bessemer's process for producing malleable iron, fine steel, or any mixture of the two which might be required in the arts or by engineers, from crude iron.

The public is justified in receiving the statements made, because it seems impossible to doubt their accuracy. The invention is momentous, involving immense interests, both in the steel and iron trade. It has,

* From the Lond. Mech. Mag., August, 1856.

like a meteor, shot across the beaten path of science, and dazzled us all by its apparant brilliancy. Having had some experience in the manufacture of both iron and steel, I propose to give the result of such experience, as well as my opinion of this novel mode of manufacture.

Mr. Bessemer runs crude fluid iron into a small cupola-formed vessel: about 7 cwt. of metal only has hitherto been operated upon, but he can as easily act upon 5 tons. A blast issuing through five tuyeres is driven into the metal at 8 lbs. or 10 lbs. pressure; and the effect obtained is, that the oxygen of the blast, uniting with the carbon, produces carbonic acid or carbonic oxide gas, which gives out a certain amount of heat. This operation goes on as long as there is carbon enough left to unite with the oxygen to produce the gas, and as the supply of carbon becomes reduced, so the ebullition of the metal, caused by the gas struggling to escape, becomes less active, and in the end entirely ceases.

When the agitation of the metal subsides, the contents must then oe tapped out, or, it is said, if the iron be allowed to remain a little longer under the action of the blast, then a spongy mass of malleable iron is obtained.

The statement publicly made is that "In 30 minutes, by the foregoing process, Mr. Bessemer converts 7 cwt. of crude metal into ingots of malleable iron or steel of any size, and fit for the various manipulations ordinarily employed." He does away with puddling, hammering, rolling, and all the subsequent operations now in daily use at our iron works. He states that fine steel is produced for the engineer, and for general manufactures, and that iron so produced is equal to Swedish or Russian, now selling at from £20 to £30.

These form the leading features and pretensions of the new process, and if so desirable a result could be obtained, truly the invention would deservedly rank amongst the first, if not the very first, of the age.

I have very carefully examined those results which might be expected from an operation like the one before us, and I cannot agree with the statements made to the public by the inventor, or by those who have seen and supported both his theory and practice.

I freely admit that a *decarbonized cast iron* is obtained--that such iron is bright, white, and crystalline; but *I do not believe* that such metal will admit of being either *drawn under a hammer, or rolled to a bar.* I cannot admit such metal into the category of cast steel, for it cannot, in my opinion, fulfil its requirements; it will not make a boring tool, or a cutter—a tap, or a die; it cannot be fashioned by the workman's hammer, or made into a needle, or cut into a file; in fine, I am compelled to give an opinion that it is a metal which cannot assume the commercial value of steel.

At this moment, when Mr. Bessemer's progress is receiving so much of the metallurgical world's attention, particularly from those whose high attainments are generally acknowledged, it may appear somewhat presumptuous to find one strong dissentient voice; yet, from the many and very careful experiments I have made, I cannot agree with a too commonly accepted opinion—that presuming cast iron to contain 5 per cent. of carbon, and steel 1 per cent., if you deprive the crude iron of 4 per cent. of its carbon, it necessarily becomes steel. This is

not the case. Mr. Bessemer's product is a decarbonized metal; the larger crystals are more decarbonized than the smaller ones, and a good lens will show that the mass is made up of small bright atoms, which are the particles least affected by the operation. The result is a metal not capable of being drawn under a hammer, or rolled to a bar; and whilst I venture to state that the process will not produce steel fit for any useful purpose, I must also add it will not produce a malleable iron suited to our wants.

I feel assured that my practical knowledge has not led me wrong in making these bold statements, which are so opposed to the generally conceived opinion. I trust they will be received in the spirit which has dictated them—not to undervalue Mr. Bessemer's exertions—but to thank him for his "mite" to that general stock of knowledge in the metallurgical art which has raised England to the elevated position she now enjoys.

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*On the Manufacture of Crown and Sheet Glass.**

(Continued from page 208.)

To return to our flattened sheets. The sheets, when annealed, are drawn from the kiln and carried to the warehouse, where they undergo examination.

Sheet glass, blown by a less complex process than crown, is liable in the glass house to a less number of defects, but after the process of flattening often makes up the deficiency; and the manner in which a sheet, spared by one process, is disfigured by another, is sometimes curiously provoking. Standing before the table of the "assorter," your eye lights upon a piece which, blown under an evil star, has imbibed in the glass-house every possible defect. The founder, skimmer, gatherer and blower, have all stamped their brand upon it. It is seedy,—the vesicles, which were in the crown tables rounded by the rotary motion of the piece, here elongated by the extension of the cylinder: it is stony,—disfigured with stony droppings from the furnace; stringy,—thin threads of glass meandering over its surface; "ambitty,"—covered with stony speckles, symptoms of incipient devitrification; conspicuous with gatherers' blisters and blisters from the pipe,—badly gathered; badly blown,—thin here, thick there, and grooved with a row of scratches; and on this abortion the flattener chances to have exerted his most exquisite skill: it has passed through his hands unscathed, flat as a polished mirror, yet, from its previous defects, entirely worthless. Next comes before you a piece whose beginning was miraculous,—no seed, no blisters: it prospered under the hands of the gatherer and blower, and left the glass house a perfect cylinder. But the croppie of the flattener marked it; the fire scalded it; dust fell upon the lagre, and dirtied it; scraps from the edges of the preceding cylinder stayed upon the lagre, and stuck to it; the stone scratched it; and the heat of the annealing chamber bent it. Such are the difficulties to which every cylinder is subject—those of the glass house, and

* From the Lond. Builder, No. 687.

those of the flattening kiln. Not all, however, are such as these: there are good as well as bad, but the good are generally in the minority.

The qualities range thus—best, seconds, thirds, fourths, and H, the latter standing for horticultural, and including all coarse glass, such as may be applied to horticultural purposes. The difficulty of escape from defects renders the best quality, as in crown glass, three times as costly as the common. The expense of production to the manufacturer is in each case the same; the materials, the labor, the fuel, the same for each. Success, therefore, clearly hinges on the proportion of good glass which a manufacturer can obtain. The six qualities of sheet glass may each consist of six different thicknesses, forming thus, in all, thirty-six varieties.

When this manufacture was new in England, the size usually blown was 36 inches long, and 20 wide. The usual size now is 47 inches long by 32 wide, and cylinders are occasionally blown 77 inches long, but large sizes and heavy weights are accomplished only by workmen of the first class. A sheet of this latter size, containing twenty-one ounces to the foot, would require for its formation a lump of glass upon the gatherer's pipe, of no less than 38 lbs. in weight.

The size which sheet glass can thus reach is obviously a great advantage, and adapts it to many purposes from which the limited dimensions of crown are excluded. It was this glass that covered the Great Exhibition in 1851. A cylinder was blown to cut, as the phrase is, 49 inches by 30: this was sub-divided into three panes of 49 inches by 10. About 300,000 of these, extending over a million square feet, and weighing upwards of 400 tons, were the work of a few weeks, and this without absorbing or disturbing the ordinary produce of the manufacturer. The energy of the glaziers was equal to their task: 18,392 panes were fixed in the roof in one week, by eighty men, 108 panes being accomplished by one man in a single day.

But sheet glass has its faults as well as its virtues: it is devoid of that brilliancy of surface for which crown is so remarkable. It is subject, also, to undulations on the surface, the precise origin of which it is difficult to explain. Mr. Shaw, in his admirable lecture on the glass manufacture, as illustrated by the Great Exhibition, speaking of this defect, says, "When the divided cylinder is softened by heat, and either allowed to flatten by its own weight, or flattened by the workmen, the concave interior of the cylinder has to expand, and the convex exterior to contract, as the curved surface becomes plane. Were this contraction and expansion to take place uniformly throughout the glass, the undulation in question would not occur, but since one part invariably yields somewhat more readily than another, perfect flatness cannot be attained."

It is, however, more probable that this undulation is produced in the operation of blowing, and is due to the double movement of the particles of glass which accompanies the formation of every cylinder, the one movement being parallel to the axis of the cylinder, and the other in planes at right angles to that axis.

Having thus briefly described the two distinct processes which converge in one result, a sheet of window glass, I shall now notice the circumstances under which these two processes have attained their present

position, and I shall here avail myself of the valuable information which M. Bontemps has provided.

We have no evidence whatever by which to determine the relative antiquity of these two processes. The cylindrical process is the only one mentioned by Theophilus in the thirteenth century, and this method was adopted by the Venetians, as the more uniform thickness which resulted from it insured, in their colored glasses, a greater uniformity of color. But in France, England, and the north of Germany, the cylindrical process fell gradually into disuse, as the demand for colored glass diminished, and at length in these countries the rotary principle exclusively prevailed, but it was so imperfectly carried out, that the tables seldom exceeded 30 inches in diameter, and were of very variable thickness.

Bohemia, however, still retained the cylindrical process which she had learnt from Venice, and with such success that when the French were in need of large and good glass, they imported it from Bohemia.

Thus it was until the commencement of the eighteenth century. Then a French officer, M. Drolenvaux, formed the project of introducing the Bohemian method into France. He constructed a company, brought workmen from Bohemia, and established a manufactory at Lettenbach, in 1730, with great success.

From this resulted, in France, Belgium, and the north of Holland, where the style of building required panes of large size, the abandonment of the rotary principle and the adoption of the cylindrical; and towards the close of the last century, a manufactory, near Abbeville, in Normandy, one in Hanover, and two others near Bamberg and Aschaffenburgh, were the last in which the rotary method was employed.

The last of these, that near Aschaffenburgh, was visited by a glass manufacturer in 1844, and he was much surprised at the very slow and unsystematic manner of proceeding which prevailed there. The gatherers held in their mouths a piece of pasteboard, turned up so as to protect their faces. The nose of the glass, after it had left the pipe and was attached to the ponty, was helped open with a piece of wood, and, after the table had been formed, it was laid upon a bed of small coal or coke and the ponty detached. The table was then piled in the annealing kiln.

In England, the manufacture of crown glass maintained its position, notwithstanding its abandonment abroad, and attained to such superiority over the spread or broad glass, to the rudeness of which I have alluded, that the former was used for all houses of the better class, while the latter was confined to poorer dwellings.

The inferiority of this spread glass, manufactured on the German principle, but by no means so good as the German glass, tended to prejudice the public against all glass manufactured on the cylindrical principle. This prejudice was, however, gradually overcome by the establishment in England of the manufacture of cylindrical glass, according to the process which I have already detailed, introduced from France, and from which resulted a glass which entirely displaced the manufacture of spread glass.

The introduction of this new manufacture was due to Mr. Chance and Mr. Hartley, who, on visiting, in 1830, the works of M. Bontemps, near Paris, were much struck with the advantages of the glass made on this

principle, and, having secured the co-operation of M. Bontemps, they commenced the process at their own works in the autumn of 1832. So great, however, were the difficulties to be overcome, that it was not till 1838 that the manufacture of this glass was completely established. Since that time there has been great progress; and the sheet glass now manufactured in this country, though inferior in color, is in other points generally superior to that of the foreign teachers.

A further development of the sheet glass manufacture in England was the process of grinding and polishing this glass by machinery, whereby a new branch of manufacture was established, which has furnished glass peculiarly applicable for purposes of which none previously existed.

A fitting companion for this, though not within the limits of blown window glass, is the remarkable invention of Mr. Hartley, by which glass, conveyed directly from the glass pot to a table, is rolled into sheets without employing in each operation more glass than is wanted for each plate of glass, however small it may be. This glass is admirably adapted for those purposes in which translucency only is required.

The greatest stimulus, however, that has been given to the crown and sheet glass manufacture was the abolition of the duty in 1845. That abolition has produced a somewhat paradoxical result. While the quantity of glass made has increased in the proportion of three to one, the number of manufacturing firms has diminished in the proportion of one to two. In 1844 there were fourteen companies engaged in the manufacture. In 1846 and 1847, following the repeal of the duty, the number had increased to twenty-four. The glass trade, after the removal of the heavy burden imposed upon it, seemed to open a fair opening for money seeking investment. The demand for glass was so great that the manufacturers were in despair. Glass-houses sprang up like mushrooms. Joint-stock companies were established to satisfy universal craving for window panes. And what was the result? Of the four-and-twenty companies existing in the year 1847, there were left, in 1854, but ten. At this time there are but seven in the whole United Kingdom. Two, established in Ireland, have ceased to exist. In Scotland, the Dumbarton Works, once famous, were closed, in 1831, by the death of the partners, afterwards re-opened, and again closed. The seven now existing are all English.

I turn, in conclusion, from this somewhat melancholy picture to a more cheering subject, the great ends which, from small beginnings, this manufacture has accomplished. The glazier of Pompeii little dreamt that the time would come when the substance that he handled, then so rare, would minister through the world to the health and pleasure of mankind; that beneath it trees would flourish, transported from a foreign soil; and that, cheaper than wood itself, it would combine with iron to form the largest building on the earth. But from Pompeii to the Crystal Palace there has been a progress of nearly twenty centuries, and a still greater progress in action than in time. That progress has been marked by no sudden revolutions, such as have distinguished the development of other efforts of mankind. The problem of blowing glass into a sheet admits of limited solutions, a cylinder or a sphere. Through one or other of these forms the first blown sheet cannot but have passed, and through one or other all pass now. But the progress has been none the less for

lack of revolutionizing discoveries. Minute and apparently unimportant changes, peceptible only to those near at hand, have in silence done their work.

Still, the development both of its processes and its applications is incomplete. Sir Joseph Paxton's glass arcade, stretching over the streets of London, and Dr. Sleigh's city of glass, in which invalids will inhale the gentle air of Madeira,—these are faint foreshadowings of the destiny of this wonderful substance.

And, perhaps, the day may come when some future chronicler of glass shall smile at the barbarians of the nineteenth century, who could not make window glass without defects, and shall exhibit those defects as curiosities of a by-gone age.

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*The Gums and Resins of Commerce.** By P. L. Simmonds.

(Continued from page 183.)

Mastic is derived from the *Pistacia lentiscus*, a very common shrub in various parts of Northern Africa, where it is sought out for its resinous produce.

In the island of Chios, where the tree is cultivated for the sake of the resin as carefully as the vine, it is customary to make small incisions in the trunk and chief branches, about the end of July. From these clefts the sap, which gradually thickens, exudes; it hangs in larger or smaller drops, and when it is very abundant, trickles on the ground and dries there. It is detached from the tree by means of a very sharp instrument; often it is caught upon cloths spread under the trees, in order to prevent any soil being derived by contact with the ground.

The largest consumption of mastic is in the East, where it is universally chewed, and thence derives its name. It is asserted to be effectual in whitening the teeth, strengthening the gums, and sweetening the breath. Mastic is also used in the preparation of the finer varnishes for pictures, &c. Owing to a recent more extensive demand for France and deficient supplies, this gum has run up in price considerably, being now vended at about 1*s.* 6*d.* the ounce. As much as 1500 cwt. was formerly annually exported from Chios. Dissolved in alcohol, mastic forms a very useful cement. It is obtained in Brazil, from the *Pistacia Atlantica*, and in Beloochistan and Affghanistan from other varieties, *P. Kinjuh* and *P. Cabulica*.

Most of the Eucalyptus genus in Australia furnish gum in abundance, particularly the red, spotted, and white gum, the iron and stringy bark and other trees. It exudes both spontaneously and in larger quantities when incisions have been made in the trunk, more particularly after rain. It is seen in masses upon the trunk, but its particles have so little tenacity, that when in a concrete form any attempt to detach them in one entire lump fails, and it crumbles immediately into innumerable fragments.

This gum resin has a strong astringent quality, and is one of the varieties of the kino of commerce.

At first it is of the consistence of very thick syrup, and immediately

*From the Journal of the Society of Arts, Lond., November, 1855.

after rain, may be seen flowing from an incision or cleft in the tree very abundantly, being then of a beautiful bright red color, becoming of a dark shining red, and hardening by exposure to the air.

The *Angophora lanceolata*, or apple tree of the colonists (a genus allied to that of Eucalyptus) also yields a dark and astringent gum from its trunk and branches. A gum as fine as amber exudes from the stem of a Macra Zamia in Australia.

The KOWRIE GUM of commerce is the produce of *Dammaris Australis*. For a long time it was much neglected, and the shipments made to this market did not repay the cost of its collection in the colony. The Americans, however, purchased it readily at first for £16 to £20 the ton, and it was used by them as a substitute for copal in the manufacture of varnish. From 14 to 17 tons come in annually to Liverpool, and within the last year or two it has been in greater favor in the London market, and larger supplies are coming forward. In 1851, 16½ tons were shipped from the port of Auckland, and in 1852, 107½ tons. This resin may be obtained in any quantity in the northern districts of New Zealand, ranging from twenty miles south of Auckland to the North Cape.

The Kowrie pine grows to a gigantic size. The gum resin exudes from it, and bears some resemblence to the dripping of a wax candle in the wind. It is now in demand for the manufacture of varnish and other purposes, and it is found in masses of several pounds weight. The Kowrie gum, though clearly the produce of this tree, is dug from the ground in quarters where no traces of trees now exist. The gum-diggers probe the soil with long iron spikes, and extract the gum thus indicated from generally a couple feet below the surface. These pieces of gum are probably the relics of primeval forests, which have disappeared long ago. The resin streams copiously from the stumps of the trees which have been felled, covering them with an appearance like wax, and hardening in the air.

BOTANY BAY GUM is a yellow resinous exudation from the *Xanthorrhœa hastilis*, and other species of the grass tree of Australia, which were generically named by Swartz, from this peculiarity. It is darker than gamboge, and less uniform in appearance, and not entirely soluble in alcohol. It has been used medicinally, to unite the edges of wounds, and in the form of tincture, with opium, in dysentery and diarrhœa, and also forms the base of a cement. This resin contains benzoic and cinnamic acid. Another species of the same family, *X. Australis*, furnishes a more brittle resin, of a brilliant dark red color, known in the colony as "black boy gum." These resins are spoken highly of as useful for varnish, and as substitutes for shellac. The grass tree is one great characteristic of the scenery and of the vegetation of Australia. It puts one in mind of a tall black native, with a spear in his hand, ornamented with a tuft of rushes. On the spear is found an excellent, clear, transparent gum, and from the lower part of the tree oozes a black gum which makes a powerful cement, used by the natives for fastening stone heads on their hammers. This gum resin may be obtained in inexhaustible quantities.

Capt. Wray, R. E., submitted a report to the local authorities of Western Australia, last year, on the manufacture of illuminating gas from the Xanthorrhœa, at one-third the expense of lighting with oil or candles.

The plant grows in abundance all over the colony, and is composed of a core of hard fibry pith, about half of its whole diameter, round which, there is a layer of resin, varying from half to one inch or more in thickness, which forms the connexion between the leaves and the core. Between these leaves, and also adhering to and covering them, is a considerable quantity of resin; resin also exudes in large lumps from the sides of the plant.

Method of obtaining the material.—In the first instance, the leaves and resin were separated from the core, by breaking up the plant with an axe, and sifting the resin from the leaves, but it was found by experience that as much gas was obtained from an equal weight of the leaves and resin together, as from the resin alone. The quantity of resin obtained from an average sized "black boy" was about 45 lbs. weight. This was collected easily, at the rate of 5 lbs. per hour, by a person having for his tools an axe and a sieve.

Should the resin be collected for export, I am satisfied that by a proper arrangement of crushers and sieves, a laborer, at 4*s.* per diem, (the colonial rate,) could collect at least one hundred weight per diem, enabling the resin to be brought to market, at Freemantle, for £4 per ton, the ton weight measuring forty-five cubic feet when pressed. The quantity of gas obtained by Capt. Wray's experiments, was at least four cubic feet to the pound of resin and leaves, but much more might be obtained by a more complete apparatus.

A cart load of the plants, 8 in number, weighed 1048 pounds. When the core was removed the leaves and resin weighed 628 pounds. This core is very good fuel when mixed with other wood. The specific gravity of the gas is 888. The products of the distillation are gas, tar, and coke. The tar obtained was about 1 quart for every 10 lbs., and this, when re-distilled, gave 8 per cent. fluid ozs. of naphtha, and 20 per cent. of a sweet spirituous non-inflammable liquor. The coke remaining was about $\frac{1}{4}$ of the original weight, and with other fuel burns well. The coke of the leaf has a bright shining appearance, and when ground with oil is a very good substitute for lamp black in paint. The gas has a smell somewhat similar to coal gas, not nearly so offensive, but sufficiently strong to make any escape immediately perceptible. Its illuminating power appears to be very superior to coal gas, and its light very white.

Captain Wray is of opinion that when the production of the gas from the resin of the Xanthorrhœa is conducted with suitable apparatus, the cost per annum will be materially reduced, so far indeed that the resin may become a large and profitable export from the colony to places which are not lit at all, or lit with oil. Among these may be enumerated Singapore, Hong Kong, Melbourne, and Adelaide.

The supply is, I may say, unlimited, and even were it not so, it would be advantageous to get rid of the plant from all the land fit for cultivation. Should, however, it be found that the plant was likely to get scarce, the resin might be obtained by tapping.

The gum resin of the New Zealand flax (*Phormium tenax*) is admirably adapted for sealing letters, and when remittances are enclosed, is frequently made use of by the colonists for that purpose. It is insoluble

either in water or spirit, and so thoroughly penetrates the envelope as to become part and parcel of it, nor is it possible to get at the contents of a letter so sealed.

One of the gum trees of Popayan in Colombia yields a resin so remarkably tenaceous, that when used to varnish ornamental work, it resists the application of boiling water, or even acids, for which reason tables, cabinets, &c., made by the Indians, and lacquered with it, are highly valued at Quito.

At Copiapo a resinous gum is obtained from the branches and berries of a shrub, with a leaf like the rosemary. It is made into cakes of two feet long, by one foot thick, and is used for paying of ships, glazing the earthen jars of the country, &c.—(*Frezier's Voyage.*)

Thenethea, the produce of an undescribed plant, is used by the Burmese as a coating for umbrellas and as a varnish.

The resins of Algiers are those from the teberinthe cedar, juniper, *pinus halepensis*, of which there are large forests, *thuya articulata*, and lentiscus, alk or lek, sanderic, mastic, and pitch and tar.

In 1853, France imported over 3 million kilogrammes of resinous substances, valued at 1,844,337 francs.

SANDARAC is obtained from the *Callitris quadrivalvis*, Rich., the *Thuya articulata*, Whal. This tree furnishes the highly prized citrus wood of the ancient Romans; and the Thuya wood of Algeria has recently again come into high repute among the French cabinet-makers. Experiments for cultivating it on a large scale are now being carried out in the French African provinces.

It should be remarked that under the generic name of Thuya, various coniferous trees furnishing resin are confounded in Algeria. Sandarac is used in the preparation of varnish, and also for making pounce.

At the Paris Exhibition a light and transparent hard resin, from Coorg, was shown, of which I have a specimen on the table. It is said to be soluble in spirit, and suited for coach varnish, but Mr. Wallis does not speak well of it. The piney varnish of the *Vateria Indica*, is a kind of dammer, which is too soft for general purposes. An Assam resin, unnamed, is also a species of dammer, on which spirits of wine has little or no action.

The Gaub tree resin from Beerpoor is a very dark amber color, which melts lighter in color by heat, and mixes with oil. There is also a more transparent lighter variety shown from Calcutta.

According to my correspondent, Mr. Ondaatje, a black resin is produced by a tree growing in the more barren parts of the district of Ceylon, in which he resides (Badulla), and belonging to the Anacardiaceæ, a tribe of plants which abounds in black resinous juice, whence the black varnishes used in China and India are obtained. It would seem to be the *Semecarpus obovatum*. From natural fissures of the bark, there runs out a clammy juice, which, at first white, becomes afterwards black by exposure to the sun's rays, hardening into masses of different sizes with pieces adhering. The resin is hard, breaks with a smooth shining fracture, burns with a bright flame, melts in fire, and is soluble in turpentine, insoluble in water, and adheres strongly to wood and metal. It is free from acridity. It forms a superior black varnish when

added to a saturated solution of vateria resin, or East Indian copal, in oil of turpentine.

Two specimens of Ceylon resin, which I have here from the Paris collection, are merely species of dammer.

(To be Continued.)

For the Journal of the Franklin Institute

Description of H. & W. Brown's Ice Boat.—Patent granted August 5th, 1856. H. Howson, Civ. Eng.

This invention consists in constructing a steamboat with a recess at the bows, the bottom of the recess consisting of two inclined shelves, one on each side, and divided by an angular rib tapering upwards from the bows, and terminating with a curve on the deck, the end of the recess forming an angle, the sides of which taper towards the bows of the boat. In connexion with the above, is employed a guard on each side suspended from and secured to the deck. The whole is arranged and constructed as fully described hereafter, for the purpose of breaking the ice, and directing the broken pieces under the body of the ice which remains unbroken on each side of the boat, thus forming a clear channel in frozen rivers and harbors, for the passage of sailing and other vessels.

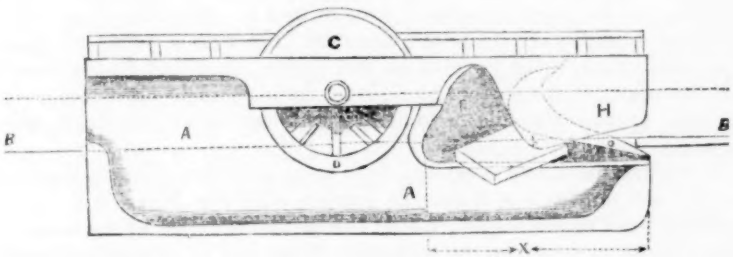
On referring to the accompanying engravings—

Fig. 1. is a side view of the ice boat.

Fig. 2. an end view looking towards the bows.

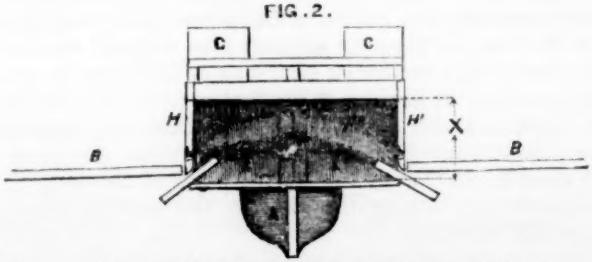
Fig. 3. a sectional plan on the line 1—2 (Fig. 1).

FIG. 1.



A is the hull of the boat; B, the water line; C, the boxes in which work the paddle wheels D, the latter being of the ordinary construction.

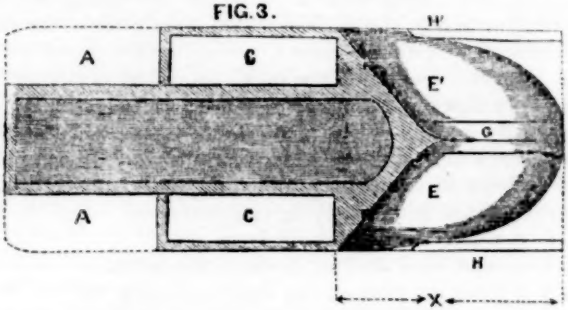
FIG. 2.



In the bows of the boat is constructed a recess x, the bottom of which

consists of two shelves E and E′, the distance between the outside edges of which at their greatest width, and viewed transversely as in Fig. 2, is the same as, or somewhat greater than, the distance between the outsides of the two paddle wheels. The edges of the opposite shelves viewed as in Fig 3, taper with a gentle curve towards a blunt point at the bows, where they meet each other. From their edges the shelves taper upwards with a rounded curve longitudinally towards the termination F and F′ of the recess, as well as laterally towards the angular projecting rib G, which separates the two shelves. This pointed rib at the bows projects slightly above the shelves, but increases in depth as it tapers upwards, and terminates with a curve at the underside of the deck (see Fig. 1). The terminations F and F′ of the recess which meet the shelves E and E′, taper towards the bows of the vessel, as seen in Fig. 3.

FIG. 3.



Suspended from the deck of the vessel, and firmly secured thereto on each side of the bows, are the guards H and H′, the points *h*, of which project a short distance below the water line. From these points the guards taper both ways, being beveled on the inside. It should be understood that the edges of the shelves E, E′, must be from 12 to 18 inches below the level of the water line B, so as to pass under ice of reasonable thickness.

Supposing the above described boat to be propelled towards a cake of ice, the first portion that comes in contact with the latter, will be the tapering point of the angular rib G; the further progress of the boat will cause the rib to so act on the underside of the ice, as to raise and consequently split the same as the boat continues to advance. The guards H and H′, will also have a tendency to break the ice at the point where their beveled edges come in contact with the latter. Thus the ice will for the most part be broken into square blocks, which must necessarily fall on each side of the projecting rib G, and on to the inclined sufaces of the shelves E and E′, as the boat continues to advance; the shape of the shelves will direct the blocks under the ice on each side of the vessel as seen in Fig. 2, and such an impetus is given to the broken pieces by the angular terminations F and F′, of the recess, that they are forced a considerable distance under the remaining ice, and thus by the propulsion of the boat, a clearer channel is cut than by the usual process of breaking up the ice into small pieces by striking the same by the bows of vessels and the action of paddle wheels.

The claim appended to the specification, is for the formation of a recess in the bows of a steamboat, said recess having inclined shelves, E and E', angular terminations, F and F', and angular rib, G, in combination with the guards, H and H', the whole being arranged and constructed substantially in the manner herein set forth, and for the purpose of breaking a channel through ice, and directing the broken pieces under the ice remaining on each side of the channel.

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*On the Manufacture of Iron and Steel by Bessemer's Process.**

To the Editor of the Mining Journal.

SIR,—In your Journal of the 16th is reported a paper, read before the British Association at Cheltenham by Mr. Bessemer, on the "Manufacture of Iron and Steel." In calling attention to the subject, I have no desire to question the value of the invention, which is almost illimitable, but as, in reading your report, the public will imbibe the false impression that Mr. Bessemer is the original patentee of the application of the principles involved in the process he describes for treating crude iron, I think it only just to those interested in the manufacture of iron, to Mr. Bessemer himself, and, above all, to my client, to remark that a patent which I obtained on behalf of Mr. J. G. Martien, of Newark, U. S., dated Sept. 15, 1855 (and noticed in the *Mining Journal* a few months ago), for "Improvements in the Manufacture of Iron and Steel," will prevent the use of Mr. Bessemer's patent, unless license be obtained from Mr. Martien, for whom I claim the honor of first inventor and patentee of the process of treating crude iron—the subjecting it to the direct agency of, and disseminating through and amongst it, atmospheric air under pressure, as it flows from, or after it has flowed from, a blast furnace, and prior to congelation, as described by Mr. Bessemer.

I trust you will see the justice of giving this claim all the publicity possible, in order to correct the false and prejudicial impressions which will otherwise exist on this important subject.

JOHN AVERY, Patent Agent, 32 Essex Street, Strand.

Paris, Aug. 19.

P. S. It may be well to mention that Mr. Martien has publicly proved his invention in Britain, prior to the date of Mr. Bessemer's patent.—J. A.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, September 18th, 1856.

B. Howard Rand, President, pro tem.
Isaac B. Garrigues, Recording Secretary.
The minutes of the last meeting were read and approved.

*From the London Mining Journal, No. 1047.

Letters were read from the Commissioners of Patents, London, Eng.; and J. Franklin Reigart, Lancaster, Pennsylvania.

Donations to the Library were presented from Mr. John Hereges, Nashville, Tenn.; J. S. Losing, Esq., Boston, Mass.; Messrs. Appleton & Co., City of New York; J. Franklin Reigart, Esq., Lancaster, Pennsylvania; George M. Conarroe, Esq., and Prof. John F. Frazer, Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of August.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (17) were proposed, and the candidates proposed at the last meeting (5) were duly elected.

W. Jones exhibited a "Summator," an instrument designed to perform the addition of numbers. It consists of a circular card, upon which the numerals from 1 up to 100, are printed at the points of intersection of a spiral line with a number of radial lines (on the instruments shown them were one hundred of the latter), the figures increasing in amount as they approach towards the centre of the card. The card is hung by a central pin to and behind a light circular plate of wood, which hides all of it except a portion which is visible through a horizontal slot, extending from the circumference towards the centre. Upon the outer edge of this plate, figures from 1 to 100 are printed in legible characters, the tens, twenties, thirties, &c., being connected in groups by strong lines, and printed in dark characters to give greater facilities in finding any desired number. Surrounding the plate is a ring of wood, which is attached to the card, and moves with it around the centre-pin; in its periphery are one hundred indentations, corresponding with the number of the radial lines, and with the figures printed around the edge of the plate. A small index slides in the slot of the plate, its motion being coincident with that of the spiral line on the card over which it always is, approaching to, or receding from the centre, as the card is turned from right to left, or *vice versa*.

The operation of adding is performed thus:—The index is placed at zero by turning the card backwards by means of a crank handle intended for that purpose; the indentation over the figure equalling the amount of the bottom line of the column to be added is brought by the revolution of the ring and card just opposite the slot in the circular plate, at which point it is arrested by a stop, against which the finger or pencil used to rotate the ring strikes, when the index will have moved towards the centre, and will mark the amount of the first line of the column to be added. The amount of the next line being taken, and the ring turned, the number shown by indicator will equal the amount of the first and second lines, and so on. To those persons who are not expert in adding, and do not care to become so, this instrument will no doubt be useful. It is mounted on a neat stand, and is a much more convenient and rapid way of adding mechanically, than the old way of slipping balls upon wires stretched in a frame, and which no doubt is familiar to all.

COMMITTEE ON SCIENCE AND THE ARTS.

Pneumatic Rotary Governor.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination the "Pneumatic Rotary Governor," invented by Mr. John Tremper, of Philadelphia, Pennsylvania—

REPORT:

That it consists of a spindle, supported in an upright position by bearings in which it is free to revolve as in ordinary governors. Upon this spindle is fitted loosely, a hub having four equally disposed radial arms, which carry near their extremities a disk of metal, capable of being moved from or towards the spindle, and fixed at the required distance by set screws, their plane surfaces being always parallel with the axial line of the spindle. Attached to the upper end of the spindle, at opposite points, are two flexible chains, which are connected with two opposite disks, and serve to suspend the hub and its attached parts. From the points of connexion for the necessary distance downwards, the spindle tapers at a rate determined by the shortening of the chains as they wind upon it when the governor is in motion.

The hub is connected by the usual appliances with a balanced throttle valve.

The belt passing over a small pulley upon the spindle, gives it a high rotative velocity, so that any small variation in the speed of the main shaft will be sensibly increased in that of the spindle.

OPERATION—When revolution is given to the spindle, the chains wind around its taper part, causing the hub to raise and revolve, (but at a less rate than the spindle,) until their tension, increasing as they approach towards a horizontal line, just equals the opposition to rotary motion made up of the inertia of the hub with its parts, and the resistance of the atmosphere to the plane surfaces of the disks, when, the spindle and the hub will have a common velocity. If the speed of the main shaft be made slightly greater, the variation is multiplied on the spindle, while the resistance of the disks prevent them from partaking in the faster speed, until the chains have wound around the spindle, drawing up the hub and increasing their tension sufficiently to equal the additional resistance due to the greater rotative velocity.

When the speed of the main shaft is diminished, the movements are reversed, the chains unwinding, and the hub falling by gravity.

The Committee entertain a very favorable opinion of this governor. It is simple in construction, almost frictionless from the absence of rubbing surfaces and joints, extremely sensitive and prompt in its action, graduating as nearly as possible the admission of steam to the work to be done by the engine.

By order of the Committee,

Philadelphia, May 8, 1856. WILLIAM HAMILTON, *Actuary.*